ENGINEERING NEWS.

THE terrible disaster on the New York Elevated, by which ten or a dozen men were swept from the structure, and four of them killed outright, was an occurrence for which it is hard to blame any individual. It was another added to many evidences that the reasonable limit of capacity of the existing lines has been already exceeded, and that such accidents, and probably much more serious ones, may be expected to result at any time. A fire had blocked the road temporarily, and as a consequence a string of cars extended from Grand street to Fiftieth, or nearly three miles, just enough before 7 A. M. to make a few minutes delay mean the loss of half a day's pay to many workingmen. Very naturally they started for the narrow unrailed employés' footwalk to reach the station but a few feet off. Then the train started—and not only one but several trains—regardless of the long string of men creeping alongside in single file. A clumsy boy left his body projecting, in trying to climb back on the cars, and swept off three men from the structure. This started a panic, and in an instant seven more fell to the street together, one pulling another over. Those still on the side-walk jumped inward on the track, regardless of a close approaching train, and except for frantic shouting of the by-standers there might have been further and greater loss of life, from panic, if nothing else.

Under any ordinary circumstances, the starting up of the trains in this fashion, regardless of the danger to those on the foot-walk alongside, would have shown the most criminal recklessness of human life, and as it is, the men responsible for it, whoever they were, certainly showed themselves too careless for their place; but it would be wrong to judge them too severely, for the pressure of traffic on the Third Avenue Elevated is so great that employés and passengers alike, get to think that trains *must be kept moving*, regardless of anything. It is a nightly occurrence to see the City Hall terminal platform crowded full of passengers to take the next incoming train, while another train alongside, waiting to go out, is completely filled with passengers standing in the aisle. The trains *usually* come in very carefully, but it needs but a drunken row, or some other provoking cause or supposed cause, to start a panic in front of an incoming train which will cause a terrible slaughter. Existing rapid transit facilities are already far outgrown, while the growth of traffic has but begun. Something different and better must be done, and that speedily, or worse than inconveniene will result.

THE Pennsylvania R. R. Co, is spending much money on the straightening of its tracks to avoid the dangerous curves in the Bergen Cut in Jersey City. This hill was cut through at an enormous expense nearly 20 years ago, and the old entrance into Jersey City shortened by two or three miles. But to meet the requirements of the then situation a curve with a 45° intersection angle was made in the rock cutting. Last year work was commenced with the purpose of avoiding this curve, including a new cutting and heavy embankments across the meadow land. It is in the last named portion of the work that the difficulty and expense is met with. At certain points many thousands of tons of earth filling have been swallowed up. At Merseles and Pryor streets this filling disappeared as fast as put in, and the first surface indication was the forcing up of the muddy land adjoining the proposed embankment to a height of 18 ft. above the normal water level. Sundry houses have been tilted on their foundations and adjoining lands affected to such a degree that the railroad company have been compelled to purchase, at very heavy figures for such unstable real estate, and now the company owns a wide strip of land on each side of its road for a very considerable distance.

A NEW method of car heating has been devised by Mr. WILLIAM FOULIS, gas engineer for the corporation of Glasgow. By his system the heat of the car lamps is utilized in heating water which imparts its heat to a stream of air which is delivered into the car near the floor. The system has been practically applied to trains on the Glasgow & South Western Railway, and, it is stated, with satisfactory results. On one occasion the temperature within the car was maintained between 52° and 54°, while the outside temperature was below freezing point; on another occasion when the atmosphere was raw and damp the temperature within the car was maintained at between 56° and 60°. This may do very well for England, where there is as yet no system of heating in general use, but it would not meet the requirements in this country.

THE shafts of the St. Clair river tunnel at Port Huron are now down on both sides of the river and the pilot tunnel (6 ft. in diameter) has been begun. The manner of excavating it is to bore a head of 12 ft. with a sort of auger and finish up and timber that much of the tunnel before beginning a similar section. The timbers are cut into such shape that they bind closely together, shutting out the water. The process of boring the large tunnel will be similar, only on a larger scale. There are ten engines, five on each side of the river, used for the hoisting and pumping and to run the electric lights that illuminate the underground operations. The soil and other conditions for working seem favorable, and the Grand Trunk now proposes to let the contract immediately for constructing the main tunnel. Gen. WM. SOOY SMITH is the contractor for the pilot tunnel.

THE surveys for the Trans-African Railway, for which an American corps left this country some six or eight months since, we learn are making very satisfactory progress, with indications of a favorable route through favorable country. We believe that this corps is the first to go from this country, but it probably will not be the last, for, as has been well pointed out by a great English writer, no one can look at what is now going on in Africa without seeing that it is repeating in the nineteenth century what was taking place on this continent in the seventeenth, and as the world moves much faster now than then, the inevitable end will probably be much the same.

THE Colorado Legislature is now discussing a "ditch bill," and the fight is between the consumers of water against what they call "royalty," and the carriers of water who demand their "rights." From the nature of the debate there are evidently two sides to the question, and both parties have rights which the proposed bill hardly allows. Some of the ditches were built by stock companies with money contributed by the farmers who now use the water, and the possession of stock is a prerequisite to obtain water. These companies claim that under the anti-royalty bill, anybody can come and demand water from their ditch at a nominal price whether he contributed to its cost or not. The main trouble really seems to lie in the price charged by other corporations, not owned by the farmers; and one speaker remarked that even at the lower rates a man was paying a mortgage of $25 per acre at 6 per cent. interest. Some legislation is evidently needed to check extravagance in construction and administration and the after charging of the same to the consumers; but as individual farmers cannot build the ditch, those who can and will must be protected in all legitimate enterprise and allowed as an inducement every reasonable return for the money expended.

THE *Chinese Times* thinks that the construction of a railway from Tientsin to Pekin at an early date is now very probable. Even the conservative Chinaman is getting tired of spending one entire day in travelling 13 miles, from Pekin to Tungchow, as referred to by the *Times*. The steel rails for the Kaiping Extension Railway have arrived at Shanghai, as have the wooden ties from Japan.

IN experiments upon the comparative durability of different kinds of timber for railroad ties, the Boston & Providence R. R. Co. reports as follows:—In December, 1878 52 ties were laid in the Boston track where the average traffic was 65 trains daily. Ten kinds of wood were used, five in the natural state, and five creosoted. The only rotten tie when recently examined was of ailanthus; but the spruce, hemlock, larch and southern pine showed much hammering effect under the rails, creosoted elm and birch did very well; the catalpa, while otherwise sound, was crushed to a pulp under the rails; chestnut was not included in the test.

PERHAPS the latest ship canal is that proposed to facilitate communication between Ceylon and India. Between the mainland and Ceylon lies the island of Ramisseram and a channel cut through it would save a sea voyage of from 300 to 400 miles. The Indian government has granted powers, conceded exclusive rights and promises aid to railway companies to induce them to extend their lines to the new port to be established.

A PLAN is proposed to build a ship canal between Birmingham (England) and the Bristol channel, with a comprehensive scheme of docks. The cost is estimated at $6,250,000. The towns of Birmingham, Gloucester, Swansea and Cardiff would unite in purchasing and improving existing canals, and constructing a new entrance 5 miles below Sharpness. It is to be hoped that the promoters will have better luck than attends the Manchester scheme.

THERE are now upwards of 20,000 miles of underground wire in the United Kingdom, the main trunk lines from London extending from 5 to 22 miles from the General Post Office; 315 offices are thus connected with the central telegraph office. In Berlin there are 7,400 miles of undeground wire, and telephone wires run from Berlin to Hanover, a distance of 211 miles. Between Paris and Brussels the telephone rate is 60 cts. for a five-minute talk.

WITH a view to economy of administration Controller CHAPIN, of New York State, has recommended to the Senate that the Adirondack survey, the State survey, the survey of State lands, engineering work, the State Board of Health and the Board of Regents be placed within the department of the State Engineer.

THE London *Railway News* says that a plan is under consideration by the leading English railways for "pooling" the receipts from parcels. At present the railway companies receive 55 per cent. of the gross receipts on parcels collected, and delivered by the Post Office, and the amount so collected is distributed among the companies in proportion to the service performed. It is this same system that they would now extend to the general parcel business.

A BILL is now before the Pennsylvania Legislature forbidding the future crossing at grade of any street, road or highway by a railroad in cities of the first and second class. If passed, this bill means that any railway company proposing to enter Philadelphia or Pittsburg must be prepared to expend large sums on tunnels and elevated structures. And it would be a good thing too; and better yet if it applied to some existing city roads.

APPARENTLY the four Boston roads which have for the last forty years had their terminus almost within a stone's throw of each other, the Lowell, Maine, Eastern and Fitchburg, have at last agreed on spending $5,000,000 on a Union station in Haymarket Square, with elevated approaches. The time is near at hand when all our large cities are to be entered in the same way, and engineers will do well to keep track of how they are designed. The Boston station is to have sixteen tracks entering the building, making room for 200 cars at once. The design is very handsome and elaborate. It is also said that a tunnel under the city is projected.

GEN. NEWTON is reported to be vigorously pushing a project looking towards the practical re-paving of the entire city of New York with either granite, asphalt or wood. The estimate given includes about 6,000,000 sq. yds., and the estimated cost is $5,000,000. No city in the country needs this improvement more than New York, and it is to be earnestly hoped that GEN. NEWTON may succeed in carrying out his plans. A respectable pavement on our main down-town streets alone would be a sufficiently great monument to any one Commissioner of Public Works.

The Registry Bureau of Philadelphia, Pa.

Written for ENGINEERING NEWS

BY JOHN H. DYE, REGISTRAR.

The history of the system in Philadelphia, for the registry of lots in the Registry Bureau, begins about the year 1860. For some years prior to this time, various parties, anticipating the extension of the city, particularly to the north and west, purchased farm lands, divided them into building lots, and sold them to numerous parties at greatly inflated prices. But few of the lots were improved and the land lay waste, with nothing visible to mark the boundaries of streets or lots, and no means of ascertaining the names of owners or the dimensions of the lots, excepting by the tedious method of examining the records in the office of the Recorder of Deeds; which was, I believe, never done unless made necessary in preparing title papers or to find property to satisfy a judgment. It is certain the Real Estate Assessors did not examine the records, as the majority of them at that time were elected by the people of the various wards, more as a reward for political work than for their general intelligence and knowledge of the values of real estate.

When the properties were improved or their owner known they were assessed; but if otherwise they were assessed as "unknown" or "not assessed"; and many hundreds were not assessed at all. The difficulty of ascertaining the dimensions and the names of the owners of lots, in many instances worked to the disadvantage of and loss to the owners themselves when municipal improvements were made, the cost of which was chargeable against the property. The bill for work done was posted upon a lot by placing a stone upon it, when the owner could not readily be found, and he would know nothing of it until possibly he was about to sell, and then find it had been sold by the sheriff to satisfy the claim. A very common trouble in this respect was Board of Health claims. A dead dog, cat or other animal found upon an unimproved lot was buried where found, and a bill for the work, amounting to the enormous sum of fifty cents, was posted upon the premises according to law: the owner having no knowledge of the matter, the bill of course would not be paid and a lien would be filed with the accumulated costs, amounting to probably fifteen or twenty dollars. The trouble would not end here.

The real owner having no notice, and his name not appearing in the publications of sale by the sheriff, the property would pass from his hands, unknown to him until too late to redeem it. During these times there were several *land sharks* who made it a business to watch all sheriff sales for opportunity to get possession of properties under these circumstances; but fortunately their business was brought to an end by the operations of our Registry System.

About the year 1860, Mr. WILLIAM NEAL, an esteemed and worthy member of the Select Council, called upon the writer to see if some means could not be adopted to protect both the city and its citizens, and asked for an estimate of the probable cost of a record. After some study a report was prepared stating that such a record could be made from the books at the Recorder of Deeds office, and future transfers could be kept up from the same source. It was estimated to cost about $75,000. It was not thought at that time to obtain legislative power to compel owners to register, but it was to be done without co-operation on the part of the property owners themselves. But the matter went no further at that time, as it was thought the city could not afford to spend so much money for a purpose that would not show immediate results. The question having been raised and discussed was not allowed to sleep; the more it was talked of the more necessary it appeared that something should be done. The first step towards the necessary legislation was an ordinance of Councils, approved Nov. 26, 1864, authorizing the Mayor to appoint a Commission of five citizens to revise the tax laws and to report some uniform rule or system upon which the actual value of all property made taxable may be ascertained, so that the same relative value of property in the aggregate, may be obtained in all the wards of the city.

In pursuance of this authority the Mayor (ALEXANDER HENRY) appointed the Commission, consisting of ELI K. PRICE, JOSEPH A. CLAY, ANDREW D. CASH, JAMES C. HAND, and WILLIAM BUCKNELL, who prepared a bill to be presented to the Legislature, entitled "an Act to promote the more certain and equal asssessments of taxes in Philadelphia;" and Councils by resolution, approved March 3, 1865, appointed a committee of three members from each chamber to present the said bill to the Legislature, and urge its immediate passage. The bill was passed and approved March 14, 1865.

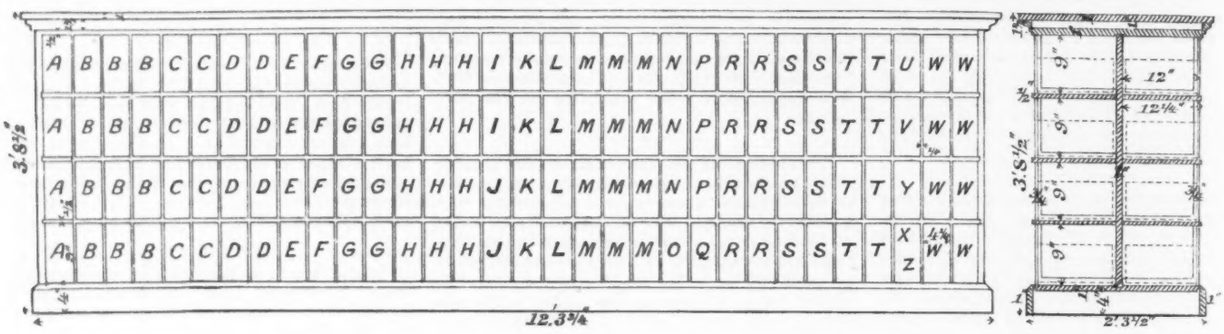
The Commission in preparing the Registry portion of the Act certainly did not conceive the magnitude of the work which they recommended, and the writer was charged with being too enthusiastic over the work when he asked for an appropriation sufficient to make ten books; not sufficient to cover two of the thirteen divisions of the city.

SECTION 2. directs the Chief Engineer and Surveyor "to cause to be made books of plans of the said city, divided into sections so far as the streets of the said city are, or shall be laid out, which shall show the situation and dimensions of each property therein, with the city house numbers thereof, and who are the owners, with such succession of blank columns as will permit the names of future owners to be entered therein, with the dates of transfers, *and with index for recording such names alphabetically.*"

This section is unusually clear and practical, and has been carried out in full, excepting the latter clause, relating to the alphabetical index. These were commenced, but they were found to be of such little use, that it would not pay to keep them up, as it would require a corps of clerks equal nearly to that employed upon the plan books; for all transfers would of necessity have to be entered twice, once opposite the name of the former owner, and again in its proper place alphabetically. There are so many persons of the same name, that if the name wanted was found, who could tell if it was the person desired? In the twenty-two years of our experience, I do not think that ten persons have asked for an alphabetical index, as every information desired can be obtained in a few minutes when the location of the lot is given.

SECTION 3, requires duplicate books to be prepared for the use of the Board of Revision of Taxes. This requirement was found to be impracticable, and was never carried out. The assessors make use of the originals in the Registry Bureau, and correct their blotters each month. A portion of this section should have been incorporated in the details of the second section as follows: "and such books (plan books) shall be kept in such manner as not to destroy the evidence of the ownerships at any previous time, but by additions which will show the subdivisions of property, and the owners thereof, as transmissions of title may take place." This requirement has been faithfully carried out; as will be seen in the actual working of the Bureau, and is a very valuable portion of the record.

SECTIONS 4, 5 and 9 detailed in a measure the form, and upon whom the duty of registering devolved. After a short practical experience, this was found to be unsatisfactory, as the Act inflicted no penalty for noncompliance, and the inducements held out in the Act were not a sufficient incentive to property owners, to cause them to take the trouble to register. To remedy the defects in that portion of the Act, the following Supplement was prepared by the writer, and thus far it has been found to work satisfactorily. The Supplement was passed by the Legislature and approved March 29, 1867.


A B B B C C D D E F G G H H H I K L M M M N P R R S S T T U W W
A B B B C C D D E F G G H H H I K L M M M N P R R S S T T V W W
A B B B C C D D E F G G H H H J K L M M M N P R R S S T T Y W W
A B B B C C D D E F G G H H H J K L M M M O Q R R S S T T X Z W W
3'8½"
12'3¾"
12"
12½"
9"
3'8½"
2'3½"

PLAN OF CASES FOR FILING DESCRIPTIONS. SCALE - ½ INCH = 1 FOOT. SECTION.

Fig. 1.

A SUPPLEMENT.

To An Act, entitled "An Act to promote the more certain and equal assessment of Taxes in Philadelphia," approved March fourteenth, one thousand eight hundred and sixty-five.

SECTION 1. Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania in General Assembly met, and it is hereby enacted by the authority of the same. That the duty of registering real estate in the City of Philadelphia shall hereafter devolve upon the purchaser, devisee by Will, the person to whom an allotment in partition shall have been made or their agent, and they shall be required to present their deeds or title papers at the Registry Bureau, so that the same may be endorsed, in accordance with the Act of Assembly to which this is Supplementary, and all owners of real estate in the said city not registered as by law directed, are required forthwith to do so, and if after three months notice, by public advertisement, in at least five daily papers of said city, two of which shall be German, and a written or printed notice shall have been served on the owner or owners, and they shall fail to have such record made, then and in that case they shall be subject to a fine of five dollars for such neglect, and in case the same is neglected for the space of six months, a lien for the accumulated fines and costs shall be filed and collected as municipal claims are now or may hereafter be by law collected, the said fines to be paid into the City Treasury. And further, no property so returned shall be subject to sale for taxes or other municipal claims thereafter to accrue as a lien of record thereon, except in the name of the owner as returned, and after recovery by suit and service of the writ on him made as in the case of a Summons.

SECTION 2. That the Sheriff of said city shall present the deeds of all property that may be sold at judicial sales, whether for partition or otherwise, and it shall be deemed a misdemeanor in office for the Clerk or Prothonotary of any Court to admit such deeds to record until the same is properly registered, and the said Sheriff is hereby authorized to demand and receive from the purchasers of such property for said duty the sum of twenty-five cents, for each deed.

SECTION 4. That the Recorder of Deeds of said city is hereby authorized and directed to refuse to admit any deed to record bearing date since the first day of July, one thousand eight hundred and sixty-five, excepting deeds conveying title to ground rents, until the same is properly registered as directed by the Act to which this is a Supplement, and upon any violation of this law by the Sheriff, Clerk or Prothonotary or any Court, Register of Wills or Recorder of Deeds, he shall be subject to a fine of five dollars, and an indictment for misdemeanor in office.

After the passage of the Act, the work of preparing the details to put it in operation was referred to me by the Chief Engineer and Surveyor, the late STRICKLAND KNEASS. I then prepared copies of the blanks as now used, with the plan of a block worked out practically, as is herewith given. Thinking possibly that some of the eastern cities, that were said to be more alive than our own, might have something better, a Committee of Councils, accompanied

by Mr. KNEASS and myself, visited New York, Boston and Providence. Nothing was found as simple and effective as our own, it was, therefore, adopted and put into operation on July 1, 1865; and although criticism has been invited from all, no alteration in the system has been suggested, and it is now operated in exactly the same form in which it was begun. The original Act intended the Registery Bureau to be primarily for the use of the assessors. It is still so used, but it has far outgrown its original intention; and is used daily by hundreds of persons, lawyers, conveyancers and others to ascertain the names of the owners of property. There are now but few conveyances of property made without a certificate of ownership having been first obtained from the Registry Bureau. During the past year no less than 9,651 such certificates were issued; the city receiving 25 cts. for each, or a total of $2,412.75.

On December 31, 1886, the total number of lots and transfers entered in the 150 books in use was 489,771.

For convenience of reference the city is divided into thirteen divisions, without any intended reference to ward lines, but as near as possible, by direct lines, to embrace areas comprising about the same number of lots; the thickly built portions being the smaller, and the rural portions the larger; working from Market street north and south in conformance with the numbering of the houses.

In preparing the plan books, we begin on the north side of Market street at the Delaware river and plot regularly to the Schuylkill river, returning to the Delaware; and continue in the same manner until the book is filled. This we call "Plan Book No. 1, North." No. 2, of course, succeeds No. 1, running north. South of Market street we begin with "Plan Book No. 1, South," and continue south in the same manner. An index plan of each division is made upon a small scale, ranging according to area from 600 to 200 ft. to the inch, showing all the streets; and in each block is lettered the book and page upon which the particular block is to be found. The clerk in attendance becomes so familiar with the various divisions, that when a particular block is wanted he turns directly to the proper index. Thus a person desiring to know the owner of a certain lot, by giving the location, can in, say two minutes have the plan and record before him.

The description of properties are copied from the deeds by their owners or their agents, upon blanks prepared by the department, of uniform size (8x10½ ins.), with printed heading and endorsement, and are folded for filing in three equal folds:

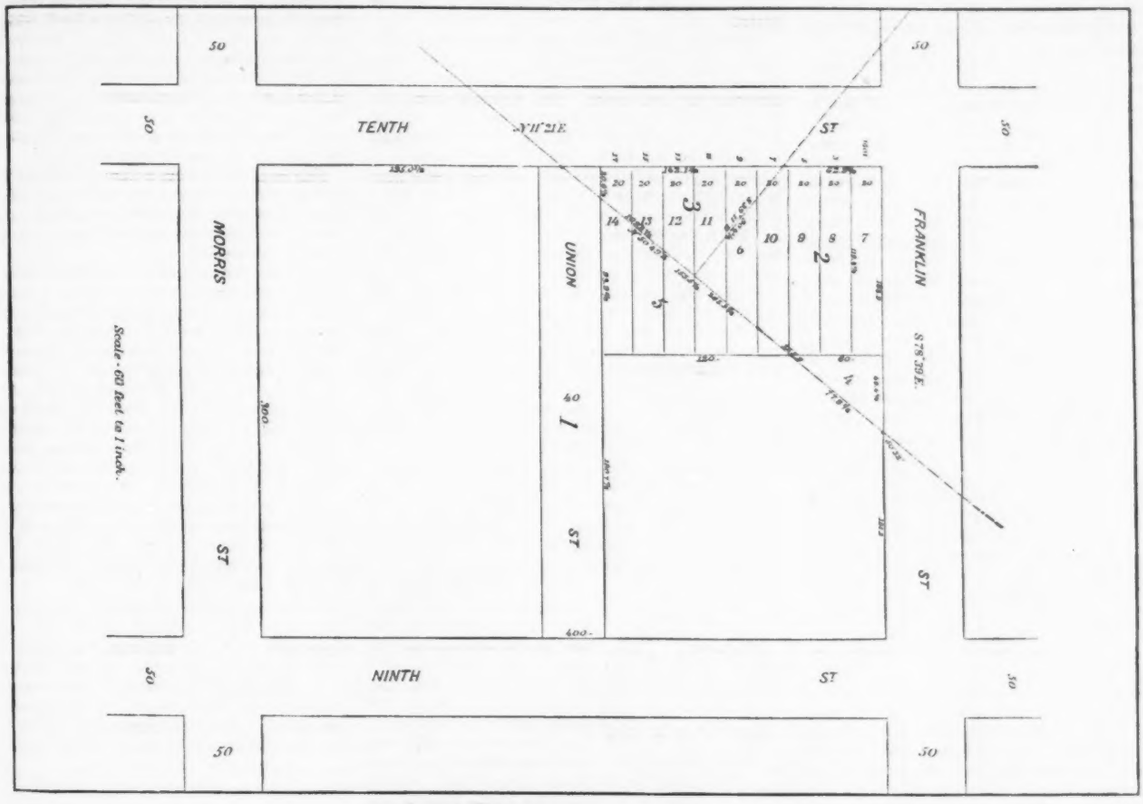


Fig. 2.—Plan of a supposed block.

Present Owner.	Former Owner.	Date of Deed.	Number of House.

All that certain lot or piece of ground.....

At the bottom).

Signature of Owner or Agent.....

(ENDORSEMENT). *Name of Present Owner.* *Entered* ____ 18__ *Lot No.* ____ *Plan Book No.* ____ *Page* ____ *No.* ____ *Street.* ____ *Ward.* ____ *Division No.* ____

DESCRIPTION BLANK.

The description, with the deed, is presented to the receiving clerk who stamps the deed with an ordinary rubber dating stamp, as having been entered in the Registry Bureau at that date. The clerk then endorses it in full excepting the lot number. The following day the draughtsman having charge of the particular division enters it in plan book and places the number of the lot upon it.

The plan books are 21 x 26 ins., each containing twenty-four pages for plans, made of half sheet Whatman's D. E. drawing paper mounted; paged by leather tags projecting from the edges and numbered on both sides. (The plans only are paged.) When the book is open the plan is upon the left, while on the right is a series of blanks for the record, with printed heading and suitably ruled for the entry of seventy-five original entries or individual lots; with succeeding space on that and the three following pages, in continuous or corresponding lines, for fourteen transfers. There are four sets of such blanks to each page of plans, sufficient for three hundred individual lots. This has been found to be ample for our most closely built up blocks, excepting in some four or five instances where we were obliged to insert an additional set. As a rule the plans are drawn to a scale of 40 ft. to an inch, and our blocks are of such dimensions as to enable us to draw two upon each page. The descriptions when entered in the plan books are arranged for filing; first, by division; secondly, by letter; thirdly, by number of book; fourthly, by page; and lastly by number of lot. By this means we are enabled to find an original description in the least possible time. These original descriptions are frequently called for and produced in court to decide questions of litigation that are constantly arising. The cases of drawers for filing descriptions are arranged as shown in Fig. 1.

To properly explain the practical working of our system, I have prepared a plan of a supposed block (Fig. 2), so arranged as to show all the various cases that arise, as to original entries, subdivisions and transfers, with the descriptions in full.* Descriptions Nos. 1, 2 and 3 show the manner in which the regular system of streets usually cut the old farm lines, and their entry requires no explanation. It is customary when the farm lines form such acute angles with the street lines, for the adjoining owners to *square* their lines to the streets by an exchange of

* The descriptions referred to will appear in next issue.—ED. ENG. NEWS.

pieces. Nos. 4 and 5 show such squaring. No. 2 being entered in the name of BENJAMIN EASTBURN and No. 3 in the name of MARK TWAIN, they are each transferred to MULBERRY SELLERS, who is thus shown to be the owner of both Nos. 2 and 3. MULBERRY SELLERS, the owner of No. 2, conveys to BARNABY RUDGE a portion of that lot, which is a subdivision and is given a new number (4). This subdivision is entered on the line of No. 2 to show that MULBERRY SELLERS has parted with that portion of his lot. BARNABY RUDGE, owner of No. 1, conveys to MULBERRY SELLERS a portion of that lot, which is a subdivision, and is given a new number (5); and this subdivision is entered on the line of No. 1 to show that BARNABY RUDGE has parted with that portion of his lot. It is supposed that in the exchange the parties have agreed, for their mutual benefit, to open an intermediate street. The record now shows that MULBERRY SELLERS' lot is a parallelogram composed of three different lots, part of No. 2, and Nos. 3 and 5, which he subdivides into smaller lots and erects buildings which are now numbered. He conveys to PAUL DOMBEY a lot, which, being a subdivision of lots Nos. 2, 3 and 5, embracing a portion of each, is given a new number (6), and the subdivision is entered upon the lines of each of those numbers. MULBERRY SELLERS, being unfortunate, has four of his houses and lots sold by the sheriff to SAMUEL WELLER. The first three are subdivisions of No. 2, and are given new numbers (7, 8 and 9), the fourth, a subdivision of No. 2, 3 and 5, is given a new number (10), and they are entered as before; in this case, as in all other cases of conveyance by sheriff, the former owner being entered as "by sheriff." The remaining four lots are conveyed to MARK TAPLEY giving the new number (11) to one, a subdivision of the three lots, 2, 3 and 5; the remaining three being subdivisions of Nos. 3 and 5 are given new numbers (12, 13 and 14) and are so entered. It will now be seen that MULBERRY SELLERS has parted with all his interest in the original lots Nos. 2, 3 and 5, and the subdivisions stand as individual lots. We therefore draw a red line through the entries of Nos. 2, 3 and 5 to show without further examination that the parties have no remaining interest in them.

It will be seen from this system of plotting, numbering and entering, that a large lot may be composed of several smaller irregular lots, and then subdivided into building lots, and we are able from the record, to state accurately the amount of ground an owner holds at any particular time.

TO BE CONTINUED.

Engineering Surveying Instruments, Their Construction and Use.

Written for ENGINEERING NEWS.

BY I. O. BAKER, C. E., PROFESSOR OF CIVIL ENGINEERING UNIVERSITY OF ILLINOIS.

VI.

The Stadia.

1. An Italian engineer (Porro) in about 1820, was the first to suggest the determination of distance in surveying by a visual angle and a rod. He proposed the name stadia; this term is applied to the instrument as a whole, although its derivation would indicate that it referred more properly to the rod. The instrument is more properly, but less frequently, called a telemeter.

The principles involved have long been well known, and have been applied in gunnery and military reconnoisance; but it is only lately that they have been used in engineering. Even now the stadia has not come into as general use as its merits demand. It was used first in Switzerland in 1836 in making a topographical survey of that country. It seems not to have been introduced into America until nearly thirty years afterward; and has not been employed to any considerable extent except in topographical surveys carried on by the U. S. Government. It is more generally used in Europe than in the United States, although it is rapidly coming into use here.

It is peculiarly adapted to topographical surveying, for it possesses the double advantage of giving both the horizontal and vertical co-ordinates, and this, too, by the most rapid method.

2. PRINCIPLE.—In all its forms the stadia depends upon the principle of the similarity of triangles. A simple form of the stadia is used in the familiar method of determining the distance of a man by measuring on a rule held at arm's length the space covered by his height. There are several forms of this simple device, but none of them are of any practical value in surveying, owing to the impossibility of focusing the eye for two distances at the same time, and second, the indistinctness of the farther object.

To employ the principle of the stadia with a telescope, it is necessary to introduce two parallel cross-hairs and observe the amount of the rod intercepted between the two hairs. The distance from the instrument to the rod varies as the space on the rod intercepted between the two hairs. The hairs may be horizontal and the rod vertical, or vice versa; the former is generally preferred. Also the hairs may be fixed, the variable distance between them being measured on the rod; or the hairs may be movable and be set to cover always the same two points on the rod, the varying distance between the hairs being measured by a graduated screw. The fixed hairs are cheaper, more simple, more accurate, and in every way better; it is the one generally used.

3. ADJUSTING THE HAIRS.—Any measuring telescope can be used as a stadia by adding a horizontal hair, but it is much better to add two extra ones, one on each side of the ordinary one. With the stadia hairs thus placed, the field of view is symmetrical about the center, and the added hairs interfere less with the ordinary uses of the telescope.

In fixing the hairs, three conditions must receive attention; they should be parallel, equally distant from the central one, and at a suitable distance from each other. The various instrument makers have different ways of making the hairs adjustable for convenience in satisfying the above conditions.

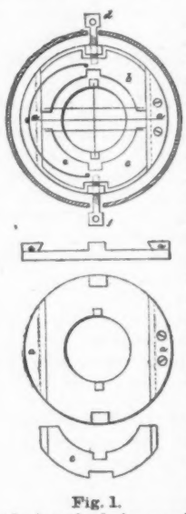


Fig. 1.

One of the most common of these is shown in the accompanying sketches. The first shows the reticule in place in the telescope tube; the others show details. The screws d and f can be operated from the outside of the telescope tube, and move (with reference to the ring a), the slides b and c, which carry the stadia hairs, e is a bent spring to take up lost motion in the screws d and f. The ring a, and all parts connected therewith, is adjusted in the telescope tube by the ordinary cross-hair screws, which are not shown. By means of the screws d and f, the distance of the stadia wires from the central wire, and from each other, can be varied at will. Lines are made upon the slides b and c to assist in placing the hairs parallel to each other.

The objections to this construction are, first, that it is expensive; second, that the projecting heads of the adjusting sewers are liable to be struck and turned in handling the instrument or in carrying it through brush, and so produce a serious error with no adequate means of detecting it; and third, since a spring must be inserted to take up lost motion, the screws have a tendency to work loose.

4. Fig. 2, shows a much better way of making the hairs adjustable a, b, c, and d are small wire plugs which are free to turn, being held only by friction; the shaded portion is in the plane of the face of the ring, the unshaded portion projects, say ⅛ of an inch above. The cross-hairs are to be stretched in the line of the centers of a and d, and c and b, and fastened at the outer edge of the ring; then, by turning the plugs, the hairs will be moved toward or from the central one, according to which side of the plug is toward the center hair. The wires may easily be made to fit tight enough not to work loose, and still turn freely enough for the above adjustment.

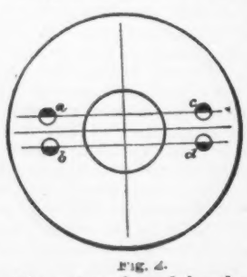


Fig. 2.

With telescope having inverting eye-pieces, which are much the best for stadia work, the wires can be turned by removing the eye-piece and without taking the reticule out of the telescope tube. With an erecting eye-piece, the hairs can be adjusted without removing the ring from the telescope tube, by making a little wrench (by cutting a kerf with a hack-saw in the end of a small strip of brass) especially for the purpose, and operating it through a hole in the telescope tube, also made for the purpose and which can be closed by a band; or the ring may be removed from the tube to adjust the stadia hairs. The telescope does not need to be collimated to test the relative position of the stadia hairs.

This method provides a way of making the hairs parallel to each other, and allows a variation in the distance between the central and each outside hair equal to the diameter of the plug. It is comparatively inexpensive.

Although the conditions specified above, for the position of the hairs, are the vigorous ones, farther on it will be shown that no appreciable error will be produced if they are only approximately satisfied. For example, the condition that the hairs should be parallel, is only necessary in case the observation is not made exactly on the vertical hair. Also if the stadia hairs are not symmetrically about the central one, it only produces an error in the vertical angle. Finally, it is immaterial what distance the hairs are apart, provided the rod is graduated to correspond. Hence it is possible to attach simply two extra hairs in the ordinary way to any measuring telescope, and thus fit it for stadia work. We will produce a formula to meet the case in which the rod is already graduated, and does not agree with the distance between the hairs.

5. The maximum distance between the hairs is limited by the size of the field of view. A magnifying power of ten will generally allow a field of view of 10°, and for greater powers proportionally less. Hence, for a telescope which magnifies ten times, the aperture may be 10° as viewed through the eye-piece, the real visual angle being 1° and the distance between the hairs $\frac{1}{10}$ of the focal length of

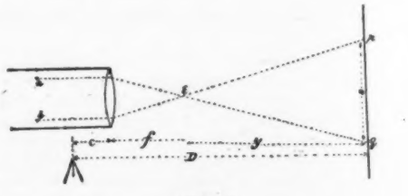


Fig. 3.

the objective. This would be about equivalent to a ratio of space on the rod to the corresponding distance from the instrument of 2 to 100. This ratio might be used for short sights, but for long sights it would repuire a rod too long to be easily handled.

On the other hand, if the hairs are very close together, the interception on the rod will be too small to be read accurately, All things considered, the best width is probably that which makes 1 ft. on the rod correspond to 100 ft. on the ground.

6. FORMULA FOR A HORIZONTAL LINE OF SIGHT AND A VERTICAL ROD.—In Fig. 3, let a and b represent the stadia hairs, and i = the distance between them; let s = the distance on the rod $p\,g$, intercepted between the hairs; let f = the focal distance of the objective; let e represent a point at a distance f in front of the optical center of the objective, or e is the outer focus of the objective; c = the distance from the plumb line of the instrument to the optical center of the objective; y = the distance from the outer focus e, to the rod: D = the distance from the instrument to the rod.

From the principles of optics, all rays of light which pass through e become parallel to each other after passing through the objective; therefore, there is some point p, which will emit a single ray of light that will pass through e and after traversing the objective, will strike the cross hair a. If the telescope is focused for the point p, the objective will bring all rays emitted by p to a focus at a; hence it is immaterial whether we consider the real course of the rays, or assume that all the light from p passes along the lines $g\,e\,a$. Similarly for the point g. Therefore, the diagram shows correctly the geometrical relations between the variables in-

volved in the determination of distance by a visual angle with a telescope.

From Fig. 3 we easily get s: $y :: i : f$, from which

$$y = \frac{f}{i} s \qquad (1)$$

and

$$D = \frac{f}{i} s + c + f \qquad (2)$$

Notice that $\frac{f}{i}$ is a constant co-efficient peculiar to each instrument, also that s varies with the distance to be determined, and that it is proportional to the distance from the rod to the outer focus of the objective.

It is now necessary to show how the numerical value of the terms $\frac{f}{i} c$ and f can be found. To find f focus the instrument on an object, say half a mile away, and measure with an ordinary rule the distance from the cross-hair to the middle of the thickness of the objective. To find c measure the horizontal distance from the vertical of the instrument to the middle of the thickness of the objective; c is not strictly constant in instruments in which the cross-hairs are fixed and the objective movable, but if the values of c and f are found within an inch it is more than sufficient.

To find the co-efficient $\frac{f}{i}$ mark a point on the ground under c (Fig. 3), by measuring a distance $= (c + f)$ from the plumb line of the instrument, and set a rod, say 100 ft., in front of this point; this distance $= y$ in equation (1). Sight through the instrument and have an assistant mark the point on the rod covered by each hair, the distance between these points correspond to s (1), we have

$$\frac{f}{i} = 100\, s.$$

If the space on the rod be then divided into this number of space, and the same graduation be carried throughout the length of the rod, then the number of divisions on the rod included in the visual angle will always be equal to the distance from the rod to the front focus of the objective.

If R = the number of divisions included in the visual angle, equation (2) then becomes

$$D = R + f + c \qquad (3)$$

The use of the preceding equation demands that each value of $\frac{f}{i}$ shall have a rod graduated to correspond. It frequently happens, from one cause or another, that it is desired to use a rod whose divisions are too great or too small; it then becomes necessary to multiply the reading by a co-efficient to correct it. Let K = this co-efficient. To find K, measure $D - (f + c)$ for some particular case, and observe the corresponding R; then K should have such a value as will make $K R$ numerically equal to

$$D - (f + c), \text{ or } K = \frac{D - (f + c)}{R} \qquad (3)$$

then becomes

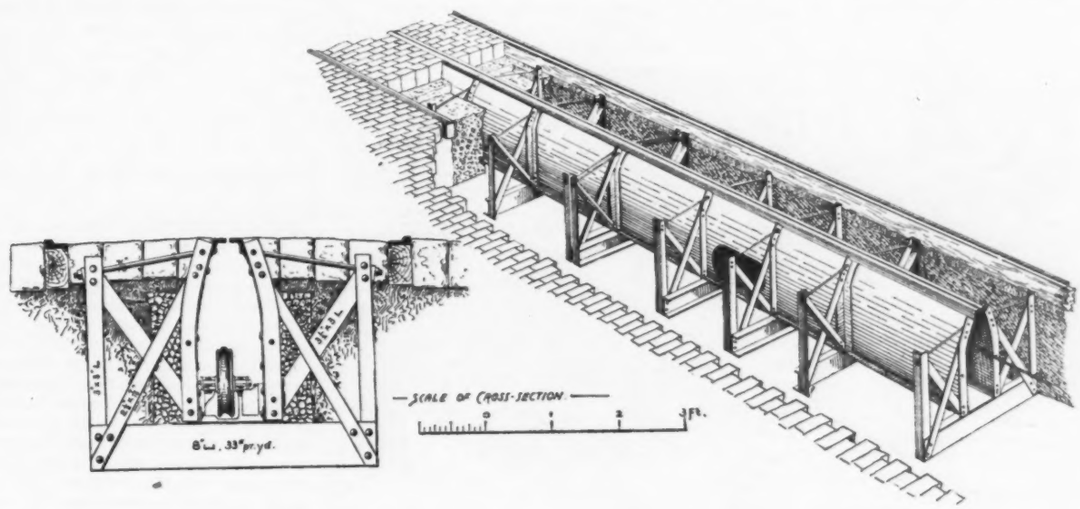
$$D = K R (f + c). \qquad (4)$$

(TO BE CONTINUED.)

The Bonzano Cable-Conduit.

In our paper upon the Municipal Engineering of Philadelphia, a section of the cable conduit of the Traction Co. was shown. Mr. A. BONZANO, Vice President and Engineer of the Phœnixville Bridge Co. and the inventor of this conduit inform us that the illustration shown does not accord with the design of the conduit as now built; the original and experimental sections were reinforced in the manner shown with wooden struts, but the improved design is as in cut given herewith.

This illustration needs little explanation, the shell is made of wrought-iron connected by angles and delivered, all riveted together, in sections; the sills are 8-in. channels weighing 33 lbs. per lineal yard, and the struts and ties for preventing the closing of the slot from any cause are made of angles flats and rods of the dimensions shown. We understand that this improved design has given every satisfaction in practical use under the most trying circumstances of season and traffic.



The Bonzano Cable-Conduit.

Electric Lighting on the Boston & Albany.

The *Springfield Republican* gives the following interesting details as to the experimental car now lighted with electricity on the Boston & Albany.

"As the car stands in the station, each platform is lighted by two large incandescent lamps suspended from the top directly over the steps. Depending from the top of the car are two rows of lamps 10 on each side of the monitor roof, coming about midway between two persons occupying a seat. The lamps are of the common incandescent style, each 16-candle power, and the light is softened by dependent bell-shaped opalescent shades.

The battery consists of 60 cells, 6¾ by 5¼ in. and 8 in. high, containing 19 plates, and weighing in all 27 lbs. For convenience in carrying, the cells are combined in boxes, and the entire battery weighs not far from a ton. It occupies a box under the center of the car, and wires lead from it to the lamps. The battery is charged during the day, the car being run on a side track. It takes some seven or eight hours to fully charge the battery, and then it will run lamps nine or ten hours. Of course if all the cars belonging to the road were lighted by storage batteries, some other method of charging them would have to be adopted. In the case of the one car now equipped, the cost is probably a little more than with oil lamps, but it is claimed that when the expense of cleaning, filling, lighting and breakage is taken into account, the incaxdescent lamps have the advantage. The Julien company furnishes the storage battery at $13 a cell, and warrants it for two years. That would be $793 for the 60 cells, or $396 a year. The cost of the fixtures, includidg the incandescent lamp, is about $2 a lamp, and each lamp is warranted for 600 hours. That would be some $288 a year for the 24 lamps. The Weston electric-light company has contracted to charge the batteries for 75 cts. a day, which would be $273 a year. This makes the cost per day $2.63 or 11 cts. a lamp for ten hours. The Julien representative in Boston claims that the battery will last four or five years, instead of two, and that the lamps will last more than 600 hours each, and of course that would bring the cost down very materially. The charges for the care of lamps amount to almost nothing."

The Pennsylvania Railroad has had substantially the same system in use on its parlor cars for about two years, but the expense reported is enormous. The average cost of lighting cars of all kinds, including baggage express and mail, is hardly more than $80 per year, including expenses of all kinds, direct and indirect, attendant thereon, as nearly as we can ascertain, but the Boston & Albany have been so well satisfied with their experiment that they have given orders to have two of their finest through trains to New York equipped with the new light, with others "as rapidly as possible" which may be merely a liberal minded reporter's way of putting it.

Scab Monkeys.

Loyal Knights of Labor should view with alarm and resist with clubs the movement to introduce imported monkey labor in this Republic. The movement, to be sure, is as yet in its beginning. Only one American citizen is thus far reported as an employer of monkeys. The man who has aimed this dastardly blow at organized labor is J. B. PARKES, of Kingston, Ky., who "has successfully trained seven large monkeys to work in his hemp field and to break and prepare the hemp for market." The animals not only do the work to the perfect satisfaction of their shameless employer, but at about one-fourth the cost of negro labor. This is a small beginning, but it is fraught with all the peril's of a crevasse in a Mississippi levee. The cruel laws of political economy will favor the extension of the plan for the cheapness of monkey labor as compared with human labor must weigh powerfully in favor of the former. Already this PARKES has sent to his brother in South Africa for ten more large monkeys. If this thing is not stopped we shall presently have millions of pauper monkeys in this country, working merely for their board and lodgings and excluding an equal or greater number of Italians and Irishmen from gainful occupations. This must not be. The Simian must go.

All the objections that the swift reasonable powers and instincts of the hoodlum have discovered and urged against cheap Chinese labor apply with tenfold force to the case of the monkey. And there are other grounds of objection which are peculiar to, and, so to speak, inherent in monkeys. The monkey is and must be a scab, hopeless and irreclaimable. He cannot be "organized." He cannot be "called out." He cannot be made to boycott EBBET'S beer. He is incapable of cultivating a dislike for non-union cocoanuts. He is too profoundly selfish to recognize the great principle that "the injury of one is the concern of all." He wears nothing but his hair, and is only in the slightest degree a consumer of the products of the toil of wage earners. He cannot be made to talk or to vote against the capitalistic skinflints. And, finally, he is a quadrumanous beast, capable in some occupations of working at the same time with all fours of his hands to take the bread from the mouths of honest laborers.

A delegation of Knights of Labor should proceed at once to Kingston, where they should hang these seven scab monkeys with their own hemp, put the miserable PARKES under the ban of a perpetual boycott, and send such a letter of warning to his collusive brother in South Africa as would cause him to abandon forthwith his abhorrent industry as a monkey purveyor.—*New York Times.*

CORRESPONDENCE.

A New Cause for Bridge Failures.

ROCHESTER, N. Y. March 5, 1887.

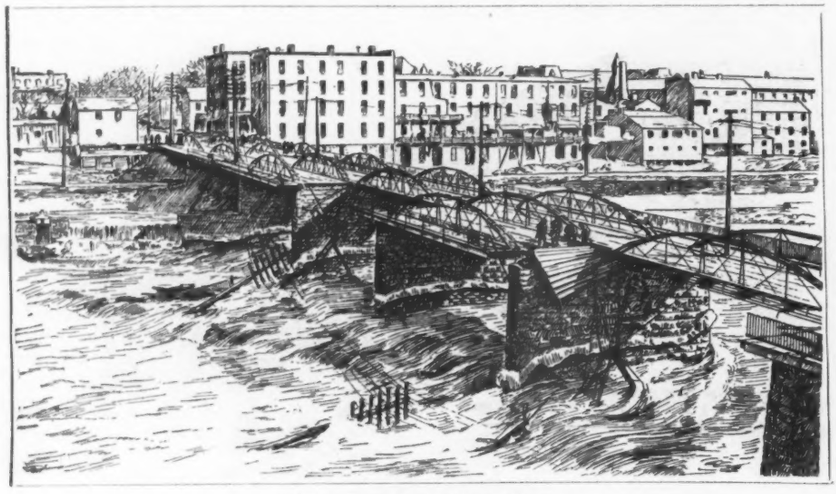
EDITOR ENGINEERING NEWS:

I enclose a photograph which illustrates a serious accident to one of the public highway bridges of this city, which occurred at midday of Feb. 18, while the bridge was in public use, and which resulted in the loss of one life.

I believe this accident to be worthy of notice in your publication, inasmuch as it is an unusual one, and serves as an example of what should be avoided in the use of bridges of similar construction.

As will be seen from the photograph this is a three truss bowstring bridge of moderate spans. It crosses the Genesee river in the heart of the city, and at times is crowded with public travel.

The Western Union Telegraph Co. had erected several large and tall poles on this structure by placing the poles through the openings in the trusses, resting them on the stringers and strapping the foot of the poles to the floor of the bridge. The poles carried thirty-four wires.



A New Cause for Bridge Failures.
Fall of a Bridge at Rochester, N. Y. (From a Photograph.)

On the morning of the accident, a gale was blowing at the rate of 44 miles an hour, according to the local observations of the United States signal service. This heavy wind, blowing against the wires and poles, brought a leverage on the trusses which they were not able to withstand, and caused their overturning, and the fall of the immediate portion of the floor which they upheld.

This is the accepted cause of the accident, and there is no evidence to the contrary.

The photograph clearly shows the floor torn out and the two fallen poles in the river still pulling at the wires. Later in the day the next adjoining pole (standing on the bridge in the photograph) fell, but instead of causing the same damage as the others, merely broke out one side of the truss.

Immediately below this bridge are the arches of the aqueduct which carries the Erie Canal over the river, and had this accident occurred three or four days previous when the water was at an *extreme* height (as shown by the ice formation on the piers) and while the aqueduct arches were flowing full, it might have blocked these openings sufficiently to have caused much greater damage. Fortunately, but one person is known to have been swept down stream, in the flood, to her death. Within half a mile, the river has a perpendicular fall of 96 ft., and a short distance further an addititional fall of 86 ft., and it is not surprising that from that day to this the body of the young woman has not been recovered.

As for the lesson of the accident it should not need to be pointed out to engineers.

I doubt if there is an engineer in the country who, having charge of such bridges, would have permitted the erection of poles thereon in this manner.

Put your bridges in charge of an authority who knows what they are made for and are able to stand, in every detail.

The executive committee of the city had forbidden the Telegraph Co. to erect these poles in this manner. Why had they not the proper authority to compel their removal? Citizens had also made complaint.

Where the authority rests, for right use of public property in this case, and who will pay for the bill of repairs, are pertinent, and so far as I am aware yet unanswered questions.

Yours very truly, GEO. B. FRANCIS, C.E.

Concerning "Fast Tunneling."

TARRYTOWN, N. Y., March 7, 1887.

EDITOR ENGINEERING NEWS:

It is, to say the least, amusing to read some of your correspondent's articles, in which they compare the efficiency of different rock boring drills by the amount of rock removed in different tunnels in a given time. There is a saying that is as nearly true as it is trite; that "good rock makes good tunnel men." And it will also apply to machine drills, when their work in a certain tunnel is compared by the work done by some other kind of drills in some other tunnel. When some people learn that some rock drills are better than others, and also that some rock will break better than others, then, and not until then, will there be an end to such comparisons. I have seen a heading, 8 x 9 ft., driven 230 ft. (which is equal to 613 cub. yds.) in a month by *one* 3⅛ in. Ingersoll drill. And I have had four 3¼ in. Ingersoll drills in a heading for a month, and only driven it 150 ft., (which was equal to 558 cub. yds.)

Now where is the man that will try to make it appear that one 3⅛ in. drill will do more work than four 3¼ in. drills. But if some one should entertain such an idea, his reasoning would not be more absurd than that of the man who thinks that because more rock is removed in a month out of a tunnel where a certain kind of drill is used, than out of another tunnel miles away where another kind of drill is used, that the best drill was working where the most rock was removed, without taking into consideration the drilling and breaking qualities of the rock in the different tunnels.

Respectfully yours, A. J. MCMILLAN.

House Numbering.

SYRACUSE, March 5, 1887.

EDITOR ENGINEERING NEWS:

Referring to Mr. BRIGDEN's letter upon "House Numbering," in your issue for February 26, (page 142), allow me the query, why he did not adopt 20 ft. for his unit space instead of 22? Had he done this, he would have had the simplest and most convenient decimal system imaginable, especially for an irregularly laid out town. Spacing each side of the street into 20 ft. sections, which should cover cross-streets as well as lot frontages, with the even numbers on one side and the odd numbers on the other, he would have had 10 ft. for each number, and the number upon each door would indicate its distance from the initial point in multiples of 10. Thus number 528 would be practically a mile from the starting point.

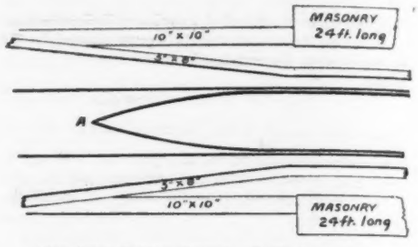
Very truly yours,
H. W. CLARKE.

The Canadian Pacific Bridge-Guard.

MONTREAL, P. Q., March 1, 1887.

EDITOR ENGINEERING NEWS:

Mr. M. J. BUTLER, Napanee, Ont., is misinformed as to the designer of the Standard bridge-guard of the Canadian Pacific Railway. If the *massive* masonry at the ends were 12 ft. long and if Mr.



Standard Bridge-Guard.—C. Shaler Smith.
[Mr. Schaub's first sketch, by error, should be masonry 24 ft., instead of 12 ft. long.]

BUTLER had shown an inner rail, coming to a frog point **A** at the end of the apron, as in the cut, he would have shown the standard bridge-guard of Mr. C. SHALER SMITH, Consulting Engineer.

Yours truly, J. W. SCHAUB.

Some Strong and Weak Points in Railroad Bridges.

EDITOR ENGINEERING NEWS:—

Without depreciating in any degree the pre-eminent merits of the Childs-Latimer system of protection for railroad bridges, it may be well to call attention to some cases where even this system would be of no avail.

On the night of September 16, last, a stray horse undertook to walk across the bridge of the Baltimore & Ohio Railroad, near Independence, O. The experiment was not a success. After proceeding a short distance on the bridge the animal stumbled and was caught between the ties, where he stuck until a freight train ran into him. The shock threw the train from the track, the cars were piled together, the bridge truss was struck and the span collapsed, carrying down the engineer and fireman, together with two men who were in the forward car. The engineer was killed and fireman badly injured.

On the 7th of last June a freight train was crossing the fine iron bridge of the Canadian Pacific Railway over the Petewawa river near Pembroke, Ont., when it was found that a steam shovel, which was next to the last car in the train, was a little too high to pass under the portal bracing. On striking the bridge the span collapsed, killing one man instantly and injuring another fatally and two more less severely. This bridge had a good floor system of close ties and efficient guard timbers all of which of course were useless when the critical time came.

On Christmas day in 1884, some cars loaded with lumber, started to run away on a down grade of the Buffalo & Southwestern Railroad, near Gowanda, N. Y. The lumber was covered with ice, so that it shifted as the cars jolted about, and when the bridge over Cattaraugus creek was reached, the truss was struck by the displaced lumber and the span fell.

On January 14, 1882, a freight train on the Chicago, Milwaukee & St. Paul Railroad ran into the rear of a preceding freight, which had stopped on the bridge over the Mississippi at La Crosse. The cars piled together and fell against the side of the bridge and one span went down.

On August 30, of the same year, a freight train on what was then the Quebec, Montreal, Ottawa & Occidental, and is now a part of the Canadian Pacific road, was crossing the iron bridge at Ste. Rose, about six miles from Montreal when one span suddenly fell with part of the train. The cause of the accident is a little obscure, but it was given out that some cord-wood on one of the cars probably shifted and struck the end post of the bridge.

On October 22, in the same year, a freight train on the New York, Lake Erie & Western Railroad broke in two near Port Jervis. The two parts afterwards collided on the bridge over the Delaware river and Delaware & Hudson canal, knocking down the canal span and dropping fifteen cars into the canal.

Even if a bridge is provided with the most elaborate system of guards there must be times when re-

newals or repairs are being made, that trains must cross when these safeguards are temporarily removed. Such was the case at the Dundee Lake bridge on the New York Susquehanna & Western Railroad. The old wooden bridge here was being renewed in iron. One new span had just been finished, and the adjoining one was on false work. On the night of September 24, last, a freight train started to cross the bridge moving slowly and cautiously as it ought to do, at a place where repairs were being made. The engine had just reached the further side, when the new iron span suddenly fell, carrying down one man, and six cars. A car probably "jumped" the track and struck one of the trusses.

Is there no way to prevent such accidents? There is. Build bridges that won't fall down if the trusses are struck. It can be done. The Oriskany Creek bridge on the New York Central, was run into by a derailed freight train in 1874,and badly demoralized. "The end post and braces of two panels of the north truss were broken off from the chord, and made into scrap iron. The north chord settled at the second floor beam about 2 ft., being prevented from going further by the support derived from the other trusses through the floor beams and top (bottom?) laterals." The wreck was cleared away, the track blocked up, and trains were crossing again within twelve hours. The bridge was a riveted lattice.

On January 14, 1878, the bridge over the Seneca river on the same road was struck in much the same manner. The end post was entirely broken off, and a number of the web members badly bent and broken. But the bridge did not fall. This too was a riveted lattice.

Some years later a derailed freight train struck one of the trusses of the Orange street bridge at Albany, a low truss riveted lattice structure. The engine fairly mounted the truss so that it was bent over sideways, and lay nearly flat against the floor. But it did not let anything through.

On April 7, 1882, a freight train ran into an open draw on the same road at Peekskill, N. Y. The cars piled up on one another, and fell over against the bridge. Both chords and number of web members were badly bent and broken, but the wreck was removed, some timbers strapped along the worst damaged members, and the bridge used without other repairs for a month or more until a new truss could be made and put in place. This also was a riveted lattice bridge.

About the middle of last August, a derailed train ran into the new iron bridge of the New York Central road over the hydraulic canal at Niagara Falls. The writer was informed that the end post of the bridge was broken substantially in two in two different places and the bridge otherwise so injured that a new end post and four new web members had to be inserted. But not only did the bridge continue to stand, but, after the wreck was cleared away, a train ran over it, injured as it was, before it could be prevented. This too was a riveted lattice bridge.

It is wise, and in the long run economical, to provide all bridges with close and heavy ties, with the Latimer rerailing device, with strong guard timbers, having wide flaring wings at the abutments, and, if the bridge be a pin-connected one, with heavy collision posts. But is it not also a pretty good idea so to build your bridge that if all these safe-guards fail and the truss does happen to get struck, it will not fall down?

An old bridge builder and railroad man once said in the writer's presence that he always trembled when riding over certain bridges lest some passenger might inadvertently stick an umbrella out of the window and hit the truss. This is probably a *little* exaggerated.

CHAS. F. STOWELL.

[We cannot "by indirections find directions out," but the burden of our correspondent's argument seems to be that a riveted bridge cannot be knocked down by any wreck, and is therefore the only style which should be used. Is not this carrying preference rather far? The umbrella point is a good one for a large percentage of both the pin-connected *and riveted* bridges which are erected, but in nineteen cases out of twenty, we take it, when a bridge falls, it will be found that either (1) it was originally too weak (2) the cars were derailed, and might have been re-railed, before the bridge was reached (3) the foundations were bad, or (4) the bridge would have been knocked down if of any type. Still, riveted bridges have undoubtedly a considerable advantage for small spans, on the score of their greater weight alone, and with spans of 100 ft. or less,there is more to be said for the old English practice of flooring bridges and carrying the ballast right over them than many American engineers are ready to admit. —ED. ENG. NEWS.]

The Sewall Car-Heater.

BANGOR, Me., Feb. 25, 1887.

EDITOR ENGINEERING NEWS:

The subject of improved methods of heating railroad cars is occupying so much attention now, that I send you an article from the Bangor *Whig* of this date. The Maine Central Railroad have been using the Sewall method of heating for the last two months on a train of three cars and have found it to work satisfactorily. They have been so well pleased with it that they have recently been fitting up other cars, and making further experiments. The results of one of these is told on the accompanying scrap. This system has been attracting some attention from railroad men of late, since the subject has been so unpleasantly forced upon the public attention by the recent terrible accidents, and I understand that the Michigan Central Railroad are about to fit up some cars with a view of testing this method.

Yours truly, T. W. BALDWIN.

"Another successful test of the merits of the Sewall heater was made Wednesday on a special train that was run over the Maine Central Railroad, from Portland to Lewiston. The train consisted of one baggage and six passenger cars, this being nearly double the size of any train previously fitted for testing the apparatus, and it was found that the last car could be as well warmed and the temperature as easily controlled as the first. And this, too, without any perceptible loss of power from the engine.

"On starting, the cars were heated to varying temperatures in order to show the amount of heat that might be generated when occasion demanded. They were from the first respectively, 90°, 89°, 70°, 75°, 88° and 86° Fahr. On the return trip every car in the train was kept at a normal temperature of 70°. The heavy grade of 80 ft. to the mile was climbed as easily as usual, thus clearly demonstrating that the steam used did not detract from the hauling capacity of the engine, but this fact seemed less wonderful when it was said that the aperture through which the cars were fed was not larger than the hole in a pipe stem.

Mr. ADAMS, of the Boston & Albany Railroad, which road has been experimenting for some time with the Martin invention, thought the Sewall heater in every way equal, if not in some respects, superior to the Martin. The hose coupling was especially mentioned, and it was claimed that it could not freeze up, and for its automatic action in case of accident, the Sewall coupler was far the best.

"A saving of at least $50 a year for each car is claimed in coal and the increase of space in each car, made by removing the stoves at present used, would result in a gain of nearly or quite a whole car in nine, making nine cars equal in carrying capacity to ten now."

A New System of Pneumatic Despatch.

The demand for the rapid transportation of passengers and freight has been well met by the railways and steam motors, but the prompt delivery of ordinary small packages of goods in our larger cities is still a slow, expensive and somewhat uncertain process, in fact little, if any, advance has been made on the methods of generations past.

There is a strong demand for an improved service, especially by the great retail stores of the present day, both in the prompt transmission of purchased goods to their destination and in the quick handling of "change" in the store itself. Pneumatic power in this connection has been used, but in a very complicated, expensive and unsightly manner. We have lately had the pleasure of personally examining a system which is intended to remove the objectionable features of present methods; a system which seems perfect in its working and yet very certain and simple in its manipulation, and above all economical for the service rendered.

This is the work of two gentlemen of this city, who brought to the work ripe engineering experience and by a long series of experiments and practical tests have evolved the system to be described. The end held in view from the start was that the system should be automatic in operation, economical in construction and provided with the fewest possible moveable parts or complication of machinery that is liable to get out of order.

In the working model examined by us these requirements seem to be fully met. The basis of the system is a rectangular air-tight tube, one for each direction of travel and preferably placed one above the other. The carrier is a box fitted with diaphragms, and on the sides of this box are placed a series of hooks only limited in number and position by the size of the tube and carrier. This carrier is inserted in the main tube by a very simple gate-device, and telegraphic or any other communication with other stations is entirely unnecessary, each station-keeper attending to his own business solely and without fear of interruption by the movements of others on the line. The delivery of the carrier at any destined station is accomplished in an ingenious manner by the engagement of the hook specially located upon the carrier for that station with a switch-track into the receiving station, somewhat after the manner in which the wards of a Yale key engage only with the wards of its particular lock. This delivery is accomplished gently and certainly, and the carrier for, say, Station 5, can only leave the main tube at that station. For large tubes intended for city package delivery these carrier-hooks are changeable; but for store-service they would be fixed so that change *must* return to the counter whence that particular carrier is sent.

The interference of a carrier with one or more already occupying the main tube is obviated by an automatic arrangement at the entering station which does not permit a carrier to start on its way until the track is clear. For store-service this system seems peculiarly well adapted, as two tubes of 2¼ in. complete a circuit that will serve five or more stations, and these can be carried under the counters and out of sight, reducing the number and consequent cost of pipes five-fold and removing the unsightly overhead complication now usually seen where pneumatic despatch is now used. For the reasons already given mistakes in returning change to the wrong counter are simply impossible. The motive power at present used is on the exhaust principle, as this has been found best adapted to this purpose.

We will in a later issue fully illustrate this new system, for though the main features are now fully protected by United States patents, other patents for slight improvements are yet pending; and it is deemed advisable to delay publication until all the details can be shown.

It has been suggested that the New York elevated railways present means for the most economical construction and satisfactory operation of a pneumatic parcel despatch system, as no disturbance of streets already crowded with pipes and conduits of various kinds would be necessary. No city needs such a system more than New York, and by using these elevated structures in no other could one be constructed so easily.

Naples, Italy.—The city having recently secured a copious supply of very excellent water, it is naturally sought to improve the present imperfect system of sewerage, and for this purpose plans have been prepared for a complete new system, having high-level sewers for the interception of the rainfall which will flow into the bay, the other part of the sewage being taken by means of an outfall, mostly in tunnel, and discharging itself at Licota, on the west coast. Extensive works are also about to be undertaken in the construction of new streets, thus opening up the closest and densest part of the city. A scheme has also been prepared for the erection of a new and enlarged abattoir, it being stated that the new buildings will cost not less than $200,000. A plan has been prepared for the construction of an underground railroad through and around the city, though as yet no steps have been taken towards the commencement of the works. Plans and estimates have been made for an extensive development of steam tramways for the province of Salerno, and negotiations are proceeding, for the execution of this work. A contract is being undertaken to supply with water the rising town of Puzzuoli, in the vicinity of which place are being erected the extensive works for Messrs. Armstrong Mitchell & Co.

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

TRIBUNE BUILDING, - NEW YORK CITY.

VOL. XVII. Saturday, March 12, 1887

D. McN. STAUFFER. A. M. WELLINGTON. EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. – UNITED STATES AND CANADA, $5.00 *per Year; $2.50 for Six Months; $1.50 for Three Months; Single Copies, 12 cents.* FOREIGN COUNTRIES, $1.50 *per Year, or 3 cents per number, additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also,* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.*

Employment Notices.—POSITIONS WANTED, *50 cents, for one insertion; $1.00 for three insertions; not over fifty words.* POSITIONS TO BE FILLED. **Free.** *Those having positions to fill are earnestly requested to avail themselves of our facilities, in the mutual interest of themselves and the unemployed.*

TABLE OF CONTENTS.

	PAGE
Engineering News	165
The Registry Bureau of Philadelphia, Pa. (*Illustrated*)	166
Engineering Surveying Instruments, Their Construction and Use (*Illustrated*)	168
The Bureau Cable-Conduit (*Illustrated*)	169
Electric Lighting on the Boston & Albany	169
Scab Monkeys	169
A New Cause for Bridge Failures (*Illustrated*)	170
Correspondence	170
A New System of Pneumatic Despatch	171
Editorial Notes	172
The Hauling Power of Locomotives	173
Personal	173
James Buchanan Eads	174
Irrigation in Lower Egypt	174
The Ownership of Water	174
Technical Notes	174
Snow Removal in Paris	175
Publications Received	176
The Manufacture of Rolled Beams in Belgium (*Illustrated*)	176
Society Proceedings	176
The Filtering Power of Various Mediums	176
Construction News	177 to 179

IN answer to several correspondents who have sent us enquiries and orders for Mr. WELLINGTON'S formulae or tables for running in transition curves we may state that the method has never yet been printed for sale, and we have no copies beyond a few lithographed copies of the table (for there is but one) prepared for use in the field. We shall shortly publish both the table and the formula on which it is based, without which the table alone would be of little service.

The method differs from all others in that it enables any offset or any length of transition curve to be used with any curve, thus greatly facilitating the ready use of these curves, as well as the field work generally. In fact, in country of any difficulty, where curves are frequent and slight readjustments of line often desirable to fit the ground better, it is easier to locate the line using these curves than not using them, since a curve can be moved several feet without changing the tangents, or *vice versa*. The methods now in print universally require, so far as we know, that the offset or the length of the curve shall be some definite distance, which limits to no good purpose the discretion of the engineer and adds much complication to the field-work.

WE would call especial attention to the description of the Registry Bureau of Philadelphia, the publication of which is commenced in this issue. The topic is a very live one at this moment, and we would again recommend a careful study of the Philadelphia method by those who are now attempting the much needed improvement on the prevailing system, or rather lack of system, in New York, and most of our other cities.

In every old and large city the division and sub-division of originally large tracts of land and the almost countless transfers of title have brought about intricacy and confusion of record that requires an expert for its correct or even safe interpretation, and a correspondingly heavy fee in the average case. The indexing of these transactions in such a simple manner that any clerk or citizen can follow the story of change of ownership and dimensions, from the present time back to the original proprietor or a sheriff's sale, is a feat of which Mr. DYE, of the Philadelphia office, can well be proud. How he does it is fully detailed in his descriptive article.

WE have received from the Providence & Worcester Railroad, apropos of the discussion of the form of the under side of rail-heads which we published in our issue of Feb. 26, a blue-print of their standard 72 lb. rail section and accompanying angle-bars which certainly to a very large extent obviate the objections which we found to exist against the Lehigh Valley Section, that there was so much metal to be ground away at a rapid rate by the very tip end of the flange, where it cuts the metal away almost as easily and as rapidly as a planing tool. We are unable to find space for an engraving of the section this week, but its main details are as follows:

The effective bearing surface of the angle-bar is only $\frac{5}{8}$-in. wide as against $\frac{3}{4}$-in. in the Lehigh Valley Section, but this is attained with a head of the same width on top ($2\frac{3}{4}$ in.) and with the sides flaring inward instead of outward, thus long postponing the day when the point of the flange cuts into the rail. The heights and bases of the rails are the same, but the Providence & Worcester weighs 4 lbs. less per yard.

The Providence & Worcester also has a less rounded corner, it being to $\frac{1}{2}$-in. radius instead of $\frac{5}{8}$-in., but the amount of "precious metal" which is even then cut off of it, will be clearer from the engraving which we shall publish than it is possible to make it now, or at least worth while to attempt.

THE *Record* of trackage of the Pennsylvania Railroad, noticed in another column, well illustrates the extent of one great evil in our railway system, the enormous and wasteful proportion of grade crossings. The Pennsylvania system has exceptionally few of these crossings, yet the figures show that it has the following large number:

Division.	Miles of Road.	No. of Crossings.			One grade crossing every
		Grade.	Under.	Over.	Miles.
East of Pittsburg & Erie	4154	85	33	45	49
Pittsburg, Ft. W. & Chicago	987	78	11	7	13
Pittsburg, Cinc. & St. Louis	952	40	0	6	24
Chicago, St. Louis & Pittsburg	583	51	0	2	11½
St. Louis, Vandalia & T. H.	158	8	0	0	20
East St. Louis and Carond	12	0	0	0	—
Grand Rapids and Michigan	558	28	0	0	20
Total Pa. system.	7404	290	44	60	25½

Probably no other line in the country, operating over 500 miles, can show anything like as large a proportion of over and under crossings, yet the last column shows that *grade crossings only* occur on the line every sixteen miles west of Pittsburg and Erie. Most of these grade crossings could have been made over or under crossings at an expense of $15,000 to $30,000, at an outside estimate, without injury to the grades, and all of them can be absolutely protected by interlocking signals at a cost of $5,000 to $8,000 each, with derailing switches and double sets of signals in each track complete, and with electric locking, so that it is absolutely impossible to bring about a crossing collision by carelessness. Once in, the expense of maintaining the apparatus is but little more than is now necessary, since the chief expense is for the watchman, who must be there in any case.

The State of Ohio averages a grade crossing every 17½ miles, at each of which an average of nearly 13,000 trains stop yearly, with an average of about fourteen cars per train. At the most moderate estimate of the cost of a stop, which we may take at 25 cts., the loss *per year* from these stops is nearly equal to the capital investment for putting in such protecting apparatus. In the States further west, the frequency of such crossings is much greater.

A CORRESPONDENT of the *Railway Age* mentions an interesting performance in the way of fast surveying on the preliminary surveys in Texas for the Missouri, Kansas & Texas extension of the Missouri Pacific Railway "between the hours of 7 A. M. and 7 P. M.," a party of fourteen were—not sentenced to be hanged, as the wording almost prepares one to expect, but able to cover 20½ miles of "railroad survey" with the level, and a little more with the transit, which quit work at 5 P. M. No horses were employed, and it may probably be admitted that this is an unparalleled performance of its kind—but a poor kind. The names of the party are given, but we refrain from repeating them, lest we might do them a professional injury.

THE controversy as to "English *vs.* American Locomotives" is still raging in the columns of *Engineering*, and many preposterous and absurd statements continue to appear, such as "the manufacturers there (i. e. here) give their parts plenty of 'play'; where we give, say, an easy fit, just a 'feel,' they give $\frac{1}{8}$ in."; "a bit of Engineering News" which ornaments a manufacturing correspondent's letter in the last issue.

In the mean time "the world continues to revolve on its axletree once in 24 hours, subject to the Constitution of the United States," and the American locomotive is doing as well as could be expected, and is able to be about as usual and attend to its business. It continues to reel off its 33,000 miles or more per year *as an average of all engines* on several great systems, and to haul in its every-day workings, as a matter of course, such loads as are given in the large inset table which appears in our issue this week; doing it all with such economy that the average cost of transport in this country is less by more than half that in any other country in the world.

In the face of these facts, it is not surprising that there is no interest taken in the discussion in this country, and little or no part taken in it by Americans. A very notable fact about it is that the controversy is almost wholly confined to Englishmen who attack and Englishmen who defend the English locomotive, and Americans must be pardoned for believing that the root of the whole controversy is an uneasy feeling of inferiority.

For another curious feature of the controversy is that the letters are either confined to *a priori* arguments as to what might, could, would or should be the case, or betray the most surprising ignorance as to what is a

Table Giving the Net Haulin

[*From the forthcoming new edition of "The Economi*

TABLE 170.

MAXIMUM WORKING LOADS FOR LOCOMOTIVES IN DAILY SERVICE (BEHIND THE TENDER) O
RATE OF GRADE, UNCOMPLICATED BY CURVATURE OR FLUCTUATIONS OF VE

Adhesion, ¼. Rolling friction, 8 lbs. Tons of 2000 lbs. (see note, end of table).

☞ *Ratio in fourth column × ¼ wt. on drivers = gross tractive power of any engine, which − wt. eng. power, behind tender.*

Tot. weight eng. and l'ded tender—tons				52	58	60	64	67	70	7
Weight engine only—tons				31	37	37	42 38	43	46	5
Weight on drivers—tons.....				20	24	28	32	36	40	4
Tons tractive power (¼ adh.).....				5.	6.	7.	8.	9.	10.	1
Rate of Grade.		Total Resistance, lbs. per net ton.	Ratio of gross w'gt of train to tractive power.	American.		Moguls and 10-wheel.			Consoli	
Per 100.	Feet per Mile.			Light. 15 × 24.	Heavy. 18 × 24.	Light 10-wheel. 17 × 24.	H'y 10-wh 19 × 14. Lt. Mog. 17 × 24.	Extra Heavy Mogul. 20 × 24.	Light (P. R.R.). 20 × 24.	Ave 20 ×
Level.	0.00	8.0	250.00	1198	1442	1690	1936	2183	2430	26
.02	1.056	8.4	238.10	1138	1371	1607	1841	2076	2311	25
.04	2.112	8.8	227.27	1084	1306	1531	1754	1978	2203	24
.06	3.168	9.2	217.39	1035	1246	1462	1675	1890	2104	23
.08	4.224	9.6	208.33	990	1192	1398	1603	1808	2013	22
.10	5.280	10.0	200.00	948	1142	1340	1536	1733	1930	21
.12	6.336	10.4	192.31	910	1096	1286	1475	1664	1853	20
.14	7.392	10.8	185.19	874	1053	1236	1418	1600	1782	19
.16	8.448	11.2	178.57	841	1013	1190	1365	1540	1716	18
.18	9.504	11.6	172.41	810	976	1147	1315	1485	1654	18
.20	10.560	12.0	166.67	781	942	1107	1269	1433	1597	17
.22	11.616	12.4	161.29	754	910	1069	1226	1385	1543	16
.24	12.672	12 8	156.25	729	879	1034	1186	1339	1492	16
.26	13.728	13 2	151.52	706	851	1001	1148	1297	1445	15
.28	14.784	13.6	147.06	683	824	969	1112	1257	1401	15
.30	15.840	14.0	142.86	662	799	940	1079	1219	1359	14
.32	16.896	14.4	138.89	642	775	912	1047	1183	1319	14
.34	17.952	14.8	135.14	624	753	886	1017	1149	1281	14
.36	19.008	15.2	131.58	606	731	861	989	1117	1246	13
.38	20.064	15.6	128.21	589	711	837	962	1087	1212	13
.40	21.120	16.0	125.00	573	692	815	936	1058	1180	13
.42	22.176	16.4	121.95	558	674	794	912	1031	1149	12
.44	23.232	16.8	119.05	543	656	773	888	1004	1120	12
.46	24.288	17.2	116.28	529	640	754	866	980	1093	12
.48	25.344	17.6	113.64	516	624	735	845	956	1066	11
.50	26.400	18.0	111.11	504	609	718	825	933	1041	11
.52	27.456	18.4	108.70	491	594	701	806	911	1017	11
.54	28.512	18.8	106.38	480	580	685	787	890	994	10
.56	29.568	19.2	104.17	469	567	669	769	871	972	10
.58	30.624	19.6	102.04	458	554	654	752	851	950	10
.60	31.680	20.0	100.00	448	542	640	736	833	930	10
.62	32.736	20.4	98.04	438	530	626	720	815	910	10
.64	33.792	20.8	96.15	429	519	613	705	798	891	
.66	34.848	21.2	94.34	420	508	600	691	782	873	
.68	35.904	21.6	92.59	411	498	588	677	766	856	
.70	36.960	22.0	90.91	403	488	576	663	751	839	
.72	38.016	22.4	89.29	394	478	565	650	737	823	
.74	39.072	22.8	87.72	387	468	554	638	712	807	
.76	40.128	23.2	86.21	379	459	543	626	709	792	
.78	41.184	23.6	84.75	372	450	533	614	696	777	
.80	42.240	24.0	83.33	365	442	523	603	683	763	
.82	43.296	24.4	81.97	358	434	514	592	671	750	
.84	44.352	24.8	80.65	351	426	505	581	659	736	
.86	45 408	25.2	79.37	345	418	496	571	647	724	
.88	46.464	25.6	78.13	339	411	487	561	636	711	
.90	47.520	26.0	76.92	333	404	478	551	625	699	
.92	48.576	26.4	75.76	327	397	470	542	615	688	
.94	49.632	26.8	74.63	321	390	462	533	605	676	
.96	50.688	27.2	73.53	316	383	455	524	595	665	
.98	51.744	27.6	72.46	310	377	447	516	585	655	
1.00	52.800	28.0	71.43	305	371	440	507	576	644	
1.02	53.856	28.4	70.42	300	365	433	499	567	634	
1.04	54.912	28.8	69.44	295	359	426	492	558	624	
1.06	55.968	29.2	68.49	290	353	419	484	549	615	
1.08	57.024	29.6	67.57	286	347	413	477	541	606	
1.10	58.080	30.0	66.67	281	342	407	469	533	597	
1.12	59.136	30.4	65.79	277	337	401	462	525	588	
1.14	60.192	30.8	64.94	273	332	395	456	517	579	
1.16	61.248	31.2	64.10	268	327	389	449	510	571	
1.18	62.304	31.6	63.29	264	322	383	442	503	563	
1.20	63.360	32.0	62.50	260	317	377	436	495	555	
1.22	64.416	32.4	61.73	257	312	372	430	489	547	
1.24	65 472	32.8	60.98	253	308	367	424	482	540	
1.26	66.528	33.2	60.24	249	303	362	418	475	532	
1.28	67.584	33.6	59.52	246	299	357	412	469	525	
1.30	68.640	34.0	58.82	242	295	352	407	462	518	
1.32	69.696	34.4	58.14	239	291	347	401	456	511	
1.34	70.752	34.8	57.47	235	287	342	396	450	505	
1.36	71.808	35.2	56.82	232	283	338	391	444	498	
1.38	72.864	35 6	56.18	229	279	333	385	439	492	
1.40	73.920	36.0	55.56	226	275	329	380	433	486	
1.42	74.976	36.4	54.95	223	272	325	376	428	479	
1.44	76 032	36.8	54.35	220	268	320	371	422	473	
1.46	77.088	37.2	53.76	217	265	316	366	417	468	
1.48	78.144	37.6	53.19	214	261	312	362	412	462	
1.50	79.200	38.0	52.63	211	258	308	357	407	456	
1.52	80.256	38.4	52.08	208	254	305	353	402	451	
1.54	81.312	38.8	51.55	206	251	301	348	397	445	
1.56	82.368	39.2	51 02	203	248	297	344	392	440	
1.58	83.424	39.6	50.51	201	245	294	340	388	435	
1.60	84 480	40.0	50.00	198	242	290	336	383	430	
1.62	85.536	40.4	49.50	195	239	286	332	378	425	
1.64	86.592	40.8	49.02	193	236	283	328	374	420	
1.66	87.648	41.2	48.54	191	233	280	324	370	415	
1.68	88.704	41.6	48.08	188	230	277	321	366	411	
1.70	89.760	42.0	47.62	186	228	273	317	362	406	
1.72	90 816	42.4	47.17	184	225	270	313	358	402	
1.74	91.872	42.8	46.73	182	222	267	310	354	397	
1.76	92 928	43.2	46.30	179	220	264	306	350	393	
1.78	93.984	43.6	45.87	177	217	261	303	346	389	
1.80	95.040	44.0	45.45	175	215	258	300	342	384	
1.82	96.096	44.4	45.05	173	212	255	296	338	380	
1.84	97.152	44.8	44 64	171	210	252	293	335	376	
1.86	98.208	45.2	44.25	169	207	250	290	331	372	
1.88	99 264	45 6	43.86	167	205	247	287	328	369	
1.90	100 320	46.0	43.48	165	203	244	284	324	365	
1.92	101.376	46.4	43.10	163	201	242	281	321	361	
1.94	102.432	46.8	42.74	162	198	239	278	318	357	
1.96	103 488	47.2	42.37	160	196	237	275	314	354	
1.93	104.544	47.6	42 02	158	194	234	272	311	350	
2.00	105.600	48.0	41.67	156	192	232	269	308	347	
2.02	106 656	48.4	41.32	155	190	229	267	305	343	
2.04	107.712	48.8	40.98	153	188	227	264	302	340	
2.06	108.768	49.2	40.65	151	186	225	261	299	336	
2.08	109 824	49.6	40.32	150	184	222	259	296	333	
2.10	110.880	50.0	40.00	148	182	220	256	293	330	
2.12	111.936	50.4	39.68	146	180	218	253	290	327	

Compute to nearest ton for 1-4 adhesion and 8 lbs rolling friction, on

TABLE 170.—*Continued.*

MAXIMUM WORKING LOADS FOR LOCOMOTIVES IN DAILY SERVICE (BEHIND THE TENDER) ON ANY GIVEN *de-facto* RATE OF GRADE, UNCOMPLICATED BY CURVATURE OR FLUCTUATIONS OF VELOCITY.

Adhesion, ¼. Rolling friction, 8 lbs. Tons of 2000 lbs. (see note, end of table).

☞ *Ratio in fourth column × ¼ wt. on drivers = gross tractive power of any engine, which − wt. eng. and tender = net tractive power, behind tender.*

Tot. weight eng. and l'ded tender—tons	52	58	60	64	67	70	75	80	87
Weight engine only—tons	31	37	37	42 38	43	46	51	55	62
Weight on drivers—tons	20	24	28	32	36	40	44	48	58
Tons tractive power (¼ adh.)	5.	6.	7.	8.	9.	10.	11.	12.	13.

Rate of Grade.		Total Resistance, lbs. per net ton.	Ratio of gross w'gt of train to tractive power.	American.		Moguls and 10-wheel.			Consolidations.			Mast'n.
Per 100.	Feet per Mile.			Light. 15 × 24.	Heavy. 18 × 24.	Light 10-wheel. 17 × 24.	H'y 10-wh 19 × 14. Lt. Mog. 17 × 24.	Extra Heavy Mogul. 20 × 24.	Light (P. R. R.). 20 × 24.	Average. 20 × 24.	Heavy. 21 × 24.	Ex. H'y, 21 × 26, or 19 × 30.
2.14	112.992	50 8	39.37	145	178	216	251	287	324	358	392	425
2.16	114.048	51.2	39.06	143	176	213	248	285	321	355	389	421
2 18	115.104	51.6	38.76	142	175	211	246	282	318	351	385	417
2.20	116.160	52.0	38.46	140	173	209	244	279	315	348	382	413
2.22	117.216	52.4	38.17	139	171	207	241	277	312	345	378	409
2.24	118.272	52.8	37.88	137	169	205	239	274	309	342	375	405
2.26	119.328	53.2	37.59	136	168	203	237	271	306	338	371	402
2.28	120.384	53 6	37.31	135	166	201	234	269	303	335	368	398
2.30	121.440	54.0	37.04	133	164	199	232	266	300	332	364	395
2.32	122.496	54.4	36.76	132	163	197	230	264	298	329	361	391
2.34	123.552	54 8	36.50	130	161	195	228	261	295	326	358	387
2.36	124.608	55.2	36.23	129	159	194	226	259	292	324	355	384
2.38	125.664	55.6	35.97	128	158	192	224	257	290	321	352	381
2.40	126.720	56.0	35.71	127	156	190	222	254	287	318	349	377
2.42	127.776	56.4	35.46	125	155	188	220	252	285	315	346	374
2.44	128.832	56.8	35.21	124	153	186	218	250	282	312	343	371
2.46	129.888	57 2	34.97	123	152	185	216	248	280	310	340	368
2.48	130.944	57.6	34.72	122	150	183	214	245	277	307	337	364
2.50	132.000	58.0	34.48	120	149	181	212	243	275	304	334	361
2.52	133.056	58.4	34.25	119	147	180	210	241	272	302	331	358
2.54	134.112	58.8	34.01	118	146	178	208	239	270	299	328	355
2.56	135.168	59.2	33.78	117	145	176	206	237	268	297	325	352
2.58	136.224	59.6	33.56	116	143	175	204	235	266	294	323	349
2.60	137.280	60.0	33.33	115	142	173	203	233	263	292	320	346
2.62	138.336	60.4	33.11	114	141	172	201	231	261	289	317	343
2.64	139.392	60.8	32.89	112	139	170	199	229	259	287	315	341
2.66	140.448	61.2	32.68	111	138	169	197	227	257	284	312	338
2.68	141.504	61.6	32.47	110	137	167	196	225	255	282	310	335
2.70	142.560	62.0	32.26	109	136	166	194	223	253	280	307	332
2.72	143.616	62.4	32.05	108	134	164	192	221	250	278	305	330
2.74	144.672	62.8	31.85	107	133	163	191	220	248	275	302	327
2.76	145.728	63.2	31.65	106	132	162	189	218	246	273	300	324
2.78	146.784	63.6	31.45	105	131	160	188	216	244	271	297	322
2.80	147.840	64.0	31.25	104	129	159	186	214	242	269	295	319
2.82	148.896	64.4	31.06	103	128	157	184	213	241	267	293	317
2.84	149.952	64.8	30.86	102	127	156	183	211	239	264	290	314
2.86	151.008	65.2	30.67	101	126	155	181	209	237	262	288	312
2.88	152 064	65.6	30.49	100	125	153	180	207	235	260	286	309
2.90	153.120	66.0	30.30	99	124	152	178	206	233	258	284	307
2.92	154.176	66.4	30.12	99	123	151	177	204	231	256	281	305
2.94	155.232	66.8	29.94	98	122	150	176	202	229	254	279	302
2.96	156.288	67.2	29.76	97	121	148	174	201	228	252	277	300
2.98	157.344	67.6	29.59	96	120	147	173	199	226	250	275	298
3.00	158.400	68.0	29.41	95	118	146	171	198	224	249	273	295
3.05	161.04	69.0	28.99	93	116	143	168	194	220	244	268	290
3.10	163.68	70.0	28.57	91	113	140	165	190	216	239	263	284
3.15	166.32	71.0	28.17	89	111	137	161	187	212	235	258	279
3.20	168.96	72.0	27.78	87	109	134	158	183	208	231	253	274
3.25	171.60	73.0	27.40	85	106	132	155	180	204	226	249	269
3.30	174.24	74.0	27.03	83	104	129	152	176	200	222	244	264
3.35	176.88	75.0	26.67	81	102	127	149	173	197	218	240	260
3.40	179.52	76.0	26.32	80	100	124	147	170	193	215	236	255
3.45	182.16	77.0	25.97	78	98	122	144	167	190	211	232	251
3.50	184.80	78.0	25.64	76	96	119	141	164	186	207	228	246
3.55	187.44	79.0	25.32	75	94	117	139	161	183	204	224	242
3.60	190.08	80.0	25.00	73	92	115	136	158	180	200	220	238
3.65	192.72	81.0	24.69	71	90	113	134	155	177	197	216	234
3.70	195.36	82.0	24.39	70	88	111	131	153	174	193	213	230
3.75	198.00	83.0	24.10	68	87	109	129	150	171	190	209	226
3.80	200.64	84.0	23.81	67	85	107	126	147	168	187	206	223
3.85	203.28	85.0	23.53	66	83	105	124	145	165	184	202	219
3.90	205.92	86.0	23.26	64	82	103	122	142	163	181	199	215
3.95	208.56	87.0	22.99	63	80	101	120	140	160	178	196	212
4.00	211.20	88.0	22.73	62	78	99	118	138	157	175	193	208
4.05	213.84	89.0	22.47	60	77	97	116	135	155	172	190	205
4.10	216.48	90.0	22.22	59	75	96	114	133	152	169	187	202
4.15	219.12	91.0	21.98	58	74	94	112	131	150	167	184	199
4.20	221.76	92.0	21.74	57	72	92	110	129	147	164	181	196
4.25	224.40	93.0	21.51	56	71	91	108	127	145	162	178	193
4.30	227.04	94.0	21.28	54	70	89	106	125	143	159	175	190
4.35	229.68	95.0	21.05	53	68	87	104	122	140	157	173	187
4.40	232.32	96.0	20.83	52	67	86	103	120	138	154	170	184
4.45	234.96	97.0	20.62	51	66	84	101	119	136	152	167	181
4.50	237.60	98.0	20.41	50	64	83	99	117	134	150	165	178
4.55	240 24	99.0	20.20	49	63	81	98	115	132	147	162	175
4.60	242 88	100.0	20.00	48	62	80	96	113	130	145	160	173
4.65	245.52	101.0	19.80	47	61	79	94	111	128	143	158	170
4.70	248.16	102.0	19.61	46	60	77	93	109	126	141	155	168
4.75	250.80	103.0	19.42	45	59	76	91	108	124	139	153	165
4.80	253.44	104.0	19.23	44	57	75	90	106	122	137	151	163
4.85	256 08	105.0	19.05	43	56	73	88	104	120	135	149	161
4.90	258.72	106.0	18.87	42	55	72	87	103	119	133	146	158
4.95	261.36	107.0	18.69	41	54	71	86	101	117	131	144	156
5.00	264.00	108.0	18.52	41	53	70	84	100	115	129	142	154
5.2	274.56	112.0	17.86	37	49	65	79	94	109	121	134	145
5.4	285.12	116.0	17.24	34	45	61	74	88	102	115	127	137
5.6	295.68	120.0	16.67	31	42	57	69	83	97	108	120	130
5.8	306 24	124.0	16.13	29	39	53	65	78	91	102	114	123
6.0	316.80	128.0	15.62	26	36	49	61	74	86	97	107	116
6.2	327.36	132.0	15.15	24	33	46	57	69	81	92	102	110
6.4	337.92	136.0	14.71	22	30	43	54	65	77	87	97	104
6.6	348.48	140.0	14.29	19	28	40	50	62	73	82	91	99
6.8	359.04	144.0	13.89	17	25	37	47	58	69	78	87	94
7.00	369.60	148.0	13.51	16	23	35	44	55	65	74	82	89
7.2	380.16	152.0	13.16	14	21	32	41	51	62	70	78	84
7.4	390.72	156.0	12.82	12	19	30	39	48	58	66	74	80
7.6	401.28	160 0	12.50	10	17	27	36	45	55	62	70	75
7.8	411.84	164.0	12.20	9	15	25	34	44	52	59	66	72
8.00	422.40	168.0	11.90	7	13	23	31	40	49	56	63	70
8.2	432.96	172.0	11.63	6	12	21	29	38	46	53	60	64
8.4	443.52	176.0	11.36	5	10	20	27	35	44	50	56	61
8.6	454.08	180.0	11.11	4	9	18	25	33	41	47	53	57
8.8	464.64	184.0	10.87	2	7	16	23	31	39	45	50	54
9.00	475.20	188.0	10.64	1	6	14	21	29	36	42	48	51
9.2	485.76	192.0	10.42	0	5	13	19	27	34	40	45	48
9.4	496.32	196.0	10.20	....	3	11	18	25	32	37	42	46
9.6	506.88	200.0	10.00	....	2	10	16	23	30	35	40	43
9.8	517.44	204.0	9.80	....	1	9	14	21	28	33	38	40
10.00	528.00	208.0	9.62	....	0	7	13	20	26	31	35	38

TENDER) ON ANY GIVEN *de-facto*
NS OF VELOCITY.
of table).
— wt. eng. and tender = net tractive

70	75	80	87
46	51	55	62
40	44	48	52
10.	**11.**	**12.**	**13.**

Consolidations. | Mast'n.

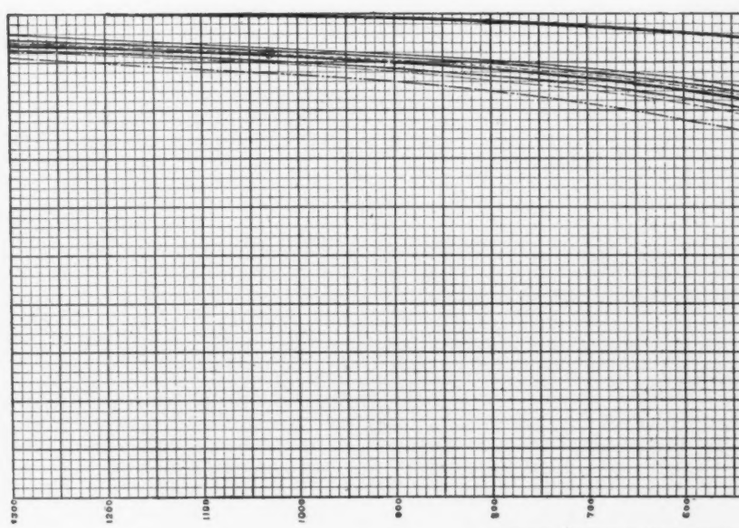
ight (P. R. R.). 20 × 24.	Average. 20 × 24.	Heavy. 21 × 24.	Ex. H'y, 21 × 26, or 19 × 30.
1430	2675	2920	3163
2311	2544	2777	3008
2203	2425	2647	2868
2104	2316	2529	2739
2013	2217	2420	2621
1930	2125	2330	2513
1853	2040	2228	2413
1782	1962	2142	2320
1716	1889	2063	2235
1664	1821	1989	2154
1597	1758	1920	2080
1543	1699	1855	2010
1492	1644	1795	1944
1445	1592	1738	1883
1401	1543	1685	1825
1359	1496	1634	1770
1319	1453	1587	1719
1281	1412	1542	1670
1246	1372	1499	1624
1212	1335	1459	1580
1180	1300	1420	1538
1149	1266	1383	1498
1120	1235	1349	1461
1093	1204	1316	1425
1066	1175	1284	1390
1041	1147	1253	1357
1017	1121	1224	1326
934	1095	1197	1296
972	1071	1170	1267
950	1047	1144	1240
930	1025	1120	1213
910	1003	1096	1188
891	983	1074	1163
873	963	1052	1139
856	943	1031	1117
839	925	1011	1095
823	907	991	1074
807	890	973	1053
792	873	955	1033
777	857	937	1014
763	842	920	996
750	827	904	979
736	812	888	961
724	798	872	945
711	784	858	929
699	771	843	913
688	758	829	898
676	746	816	883
665	734	802	869
655	722	789	855
644	711	777	842
634	700	765	828
624	689	753	816
615	678	742	803
606	668	731	791
597	658	720	780
588	649	709	768
579	639	699	757
571	630	689	746
563	621	679	736
555	612	670	725
547	604	661	715
540	596	652	706
532	588	641	696
525	580	634	687
518	572	626	678
511	565	618	669
505	557	610	660
498	550	602	652
492	543	594	643
486	536	587	635
479	529	579	627
473	523	572	620
468	516	565	612
462	510	558	604
456	504	552	597
451	498	545	590
445	492	539	583
440	486	532	576
435	481	526	570
430	475	520	563
425	469	514	556
420	464	508	550
415	459	502	544
411	454	497	538
406	449	491	532
402	444	486	526
397	439	481	520
393	434	476	515
389	430	470	510
384	425	465	504
380	421	461	498
376	416	456	493
372	412	451	488
369	407	446	483
365	403	442	478
361	399	437	473
357	395	433	469
354	391	428	464
350	387	424	459
347	383	420	455
343	380	416	450
340	376	412	446
336	372	408	441
333	369	404	437
330	365	400	433
327	361	396	429

ion on tangents, even half-tone

1.92	101.376	49.4	[illegible]							
1.94	102.432	46.8	42.74	162	198	239	278	318	357	
1.96	103.488	47.2	42.37	160	196	237	275	314	354	39
1.98	104.544	47.6	42.02	158	194	234	272	311	350	38
2.00	105.600	48.0	41.67	156	192	232	269	308	347	38
2.02	106.656	48.4	41.32	155	190	229	267	305	343	38
2.04	107.712	48.8	40.98	153	188	227	264	302	340	37
2.06	108.768	49.2	40.65	151	186	225	261	299	336	37
2.08	109.824	49.6	40.32	150	184	222	259	296	333	36
2.10	110.880	50.0	40.00	148	182	220	256	293	330	36
2.12	111.936	50.4	39.68	146	180	218	253	290	327	36

Corrrect to nearest ton for 1-4 adhesion and 8 lbs rolling friction on tang
being dropped.

Applicable to either long or short tons, or any other unit, if the weights of engi
given in tons of the same kind. The table gives simply, in effect, the **ratio** of net load behind
hesion, assumed at ¼ the weight on drivers, for each even ton of adhesion, or each 4 tons on
ate weights can be interpolated by inspection. Adding total weight (as assumed)
given in the heading gives the gross weight **of engine and train** which an engine of any
can take up any grade with ¼ adhesion. **For 1-3 adhesion** the gross load will be 33⅓ per
1-5 adhesion 20 per cent. less. The net load varies slightly with the pattern of engine.
having any given weight on drivers, correct the table by the difference between its actual
that assumed for an engine with tender, with same load on drivers, in preparing this table.



Net Train-Load in Tons Behin

Diagram Showing the Hauling Power of En

NOTES TO DIAGRAM.

This diagram, which constitutes Fig. 169 of the forthcoming new edition of "The Economic Theory of the Location of Railways," is reduced from one prepared by Mr. G. W. CUSHING, Supt. of Motive Power, Northern Pacific Ry., with certain lines added. It is somewhat confusing on first examination, from the fact that it is not constructed according to established geometric

methods
tion **O**.
right, as
the incre
is explai
the edito

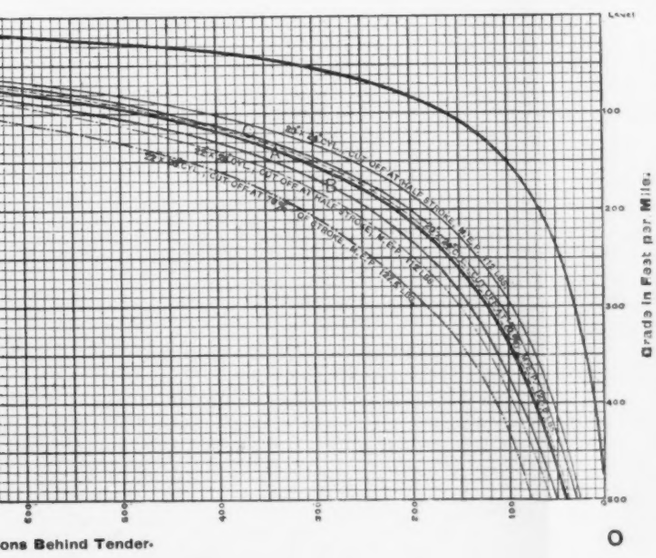
4	391	428	464										
0	387	424	459										
7	383	420	455										
3	380	416	450										
0	376	412	446										
6	372	408	441										
33	369	404	437										
30	365	400	433										
27	361	396	429										

on tangents, even half-tons

ts of engine be supposed to be
l behind engine to the total ad-
tons on drivers. **Intermedi-**
ssumed) of engine and tender
ne of any pattern whatsoever
e 33⅓ per cent. greater, and **for**
f engine. **For tank engines**
ts actual weight in service, and
is table.

8.00	499.40	168.0	11.90										
8.2	432.96	172.0	11.63	6	12	21	29	38	46	53	60	66	
8.4	443.52	176.0	11.36	5	10	20	27	35	44	50	56	61	
8.6	454.08	180.0	11.11	4	9	18	25	33	41	47	53	57	
8.8	464.64	184.0	10.87	2	7	16	23	31	39	45	50	54	
9.00	475.20	188.0	10.64	1	6	14	21	29	36	42	48	51	
9.2	485.76	192.0	10.42	0	5	13	19	27	34	40	45	48	
9.4	496.32	196.0	10.20	....	3	11	18	25	32	37	42	46	
9.6	506.88	200.0	10.00	....	2	10	16	23	30	35	40	43	
9.8	517.44	204.0	9.80	....	1	9	14	21	28	33	38	40	
10.00	528.00	208.0	9.62	....	0	7	13	20	26	31	35	38	

The above table gives us the fair working capacity for locomotives in every day service on *de-facto* grades of the given rate, as evinced by the daily practice of many lines (see Table 138.) In **single tests** they will run some 20 per cent. higher; in winter weather, about 10 per cent. lower. Otherwise any considerable excess in reported loads above the preceding table indicates simply that the grades are not in reality as high as reported, but are probably operated as momentum grades; and any considerable deficiency indicates either carelessness in loading engines to their capacity or that the profile grades are in effect increased by unreduced curvature or stopping-points on the maximum grade. Thus, a *de-facto* level grade for operating purposes hardly exists in the world; nor can it, except with a very unequal traffic enabling all curves and stations to be on a descending grade without impeding up traffic.



wer of Engines on Various Grades.

methods, with a common origin for the two coördinate axes at their intersection **O**. It can best be studied by regarding the side of the diagram to the right, as the horizontal axis (axis of x), and regarding the curves as indicating the increase of net load from progressive diminutions of grade resistance. It is explained further in the discussion of "The Hauling Power of Engines" on the editorial page.

Regarding this end of the diagram as the base-line (or "axis of x") as explained beneath the title to it:

1. *The lower heavy line* represents the progressive increase of train-load (behind tender) as the grade is reduced, for the *lightest American engine* given in Table 170, which begins at **O** at a grade of 480 ft. per mile, and ends at 1198 tons on a level, just within the limits of the diagram.

2. *The upper heavy line*, marked **A**, represents the same thing for the *heaviest Mastodon engine* given in Table 170 above, so nearly that it is not in error by more than its own width at any point. It was not plotted for that purpose, however, but was one of the lines of the original diagram, as explained on editorial page, made blacker to correspond with line 1.

Similar lines for all the other nine engines whose tractive capacities are given in Table 170 above, would fall between these two lines at approximately regular intervals. It has not seemed necessary to plot them.

The remaining lines of the diagram give the cylinder and adhesion tractive powers separately for the three different engines below detailed, as computed by Mr. G. W. CUSHING, Supt. M. P. No. Pac. Ry., on the following assumptions:

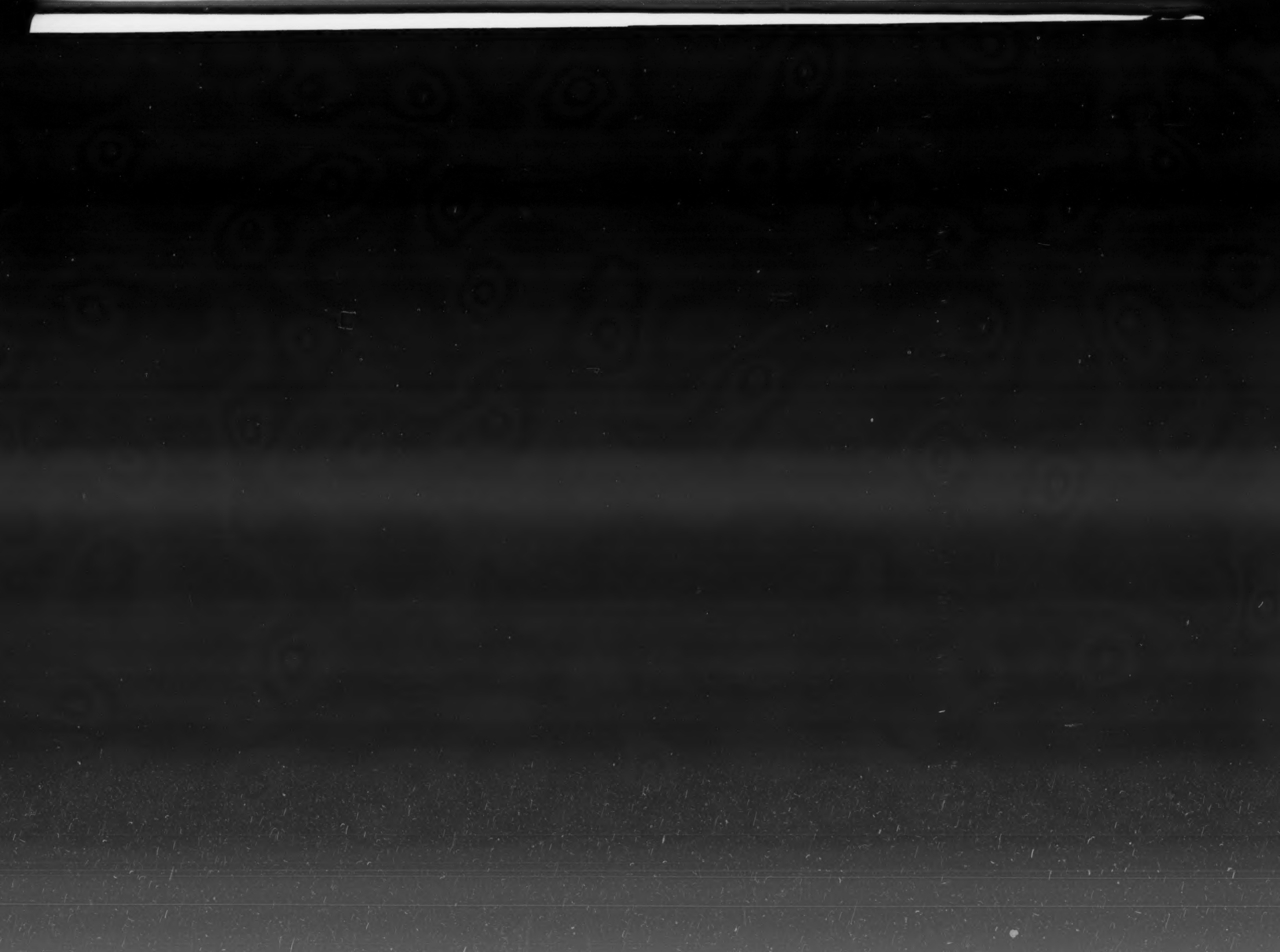
Rolling-friction, 6½ lbs. per ton in place of 8 lbs. per ton, as for the table above.

Ratio of adhesion, ¼, as in this volume.

The difference in the rolling-friction makes the train-loads somewhat greater than those given in Table 170, especially as a level is approached, but makes no great difference on the higher grades. The three engines are as follows:

Engine.	Cylinders.	Drivers.	Trac. Pr. in Lbs., Per Lb. of Effective Pressure.	No. Drivers.	Weights.			
					On Drivers.	Total Engine.	Tender, Loaded.	Total.
	Inches	Inches						
A	22 x 26	49	256.8	8	100,000	112,000	65,000	177,000
B	22 x 26	49	256.8	10	110,000	112,000	65,000	177,000
C	20 x 24	49	196	8	96,000	108,000	65,000	173,000

The further lines of the diagram are explained on the editorial page.



proper basis for a comparison of locomotive performance. With all due respect to our English friends, the question [of which engines burn the most coal per horse power per hour, or even cost most per mile run for maintenance (although we may challenge comparison in that respect) is nothing to the purpose. The only true basis of comparison is: Under fairly analogous working conditions, which engines make the most miles, haul the greatest loads, earn the most money, *reduced to a uniform tariff rate*, and cost the least per mile run per ton or per passenger? On this basis, as we may shortly take occasion to show by abundant definite figures, the American locomotive is so far the first that there is no second.

The Hauling Power of Locomotives.

Simple as the problem seems, there are few computations in which error is easier than in computing the hauling power of locomotives, nor is there any in which errors are oftener made. For example, on the same page (510) of Vose's *Manual for Railroad Engineers* are given a dozen or so computations in extracts from official reports of two different and very eminent and able engineers, BENJ. H. LATROBE and Gen. HERMANN HAUPT, *every one* of which is materially in error, and in different ways. Again, on page 606 of the latest edition of HASWELL'S *Pocket Book* is given a computation by another able and well known engineer, Mr. O. CHANUTE, of the hauling capacity of an American engine with a tractive power of 10,650 lbs. up a 0.9 grade (47 ft. per mile) as an example of the application of his formulæ, which is figured out as "395 tons, or about 20 cars," whereas the large inset table which we give this week shows a hauling capacity of only 350 tons for such an engine and grade. The explanation is, that the entire gravity resistance of the engine was left out of the larger calculation.

These examples are all of cases where especially experienced men made computations for which especial care might have been expected to be used. They had, moreover, to pass the scrutiny of the authors of the works referred to before they were admitted to the volume, and of many readers and students later; yet it remained for the present writer to discover them. It hardly needs further evidence that in less important, and less careful computations many errors are committed, for we all share more or less the infirmity of the most profound of mathematicians, who could never add up a column of figures correctly.

A table by which the proper hauling capacity of any engine on any grade can be at once determined by inspection, therefore, is something which every engineer may well find useful, and still more railroad men who are not engineers, and such a one—the first one so far as we know ever computed—we are enabled to present to our readers, as a supplement to this issue.

A few words of explanation are needed to make the table more useful. In the first place, there is the very vital and fundamental question: WHAT IS A GRADE? There are few readers of this journal, perhaps, who do not think they know what a grade is, yet there is, perhaps, no engineering question which is less generally understood. For the grades of the profile are very rarely the real grades, and a mistaken notion that they are causes much of the confusion of evidence as to what the real capabilities of the locomotive are.

Three causes intervene to prevent it; first, the effect of momentum (to use the popular term) enabling engines to "float" over moderate elevations without exerting anything like the power which the nominal rate of grade calls for; so that undulating 50 or 60 ft. grades, going up and down summits of 60 or 80 ft. high, not only can be, but are operated as virtual levels. This cause alone immensely modifies the rate of all grades which rise less than 100 or 200 vertical feet, even for freight service, so that the profile grades are really no evidence at all as to what the hauling capacity of even slow freight trains should be over them, without taking this into account. It is a simple matter to do this, but it would lead us too far to enter now into the question of how to do it.

Secondly, the converse of the preceding, comes the effect of stopping and starting. If there be a stop on any part of a grade, or anywhere very near to the foot of it, the virtual rate of the grade will be very much increased, unless the grade be heavily reduced at the stopping point, which is rarely the case. Perhaps the best illustration of the importance of this effect (and we cannot now attempt more than to illustrate it) is the effect of the numerous stops on the New York elevated railways. Assuming the actual grade to be a level, the virtual grade resulting from the frequent stops is 2¾ per cent., or 145 ft. per mile. That is to say, the demand upon the tractive power of the engine is as great, to handle the trains as they must be handled, as if the train had to be hauled up a continuous grade of 145 ft. per mile at its average speed, or to make a rise of 1,160 ft., vertical in its run of eight miles. We do not say that the total work done must be as great; that is an entirely different question; but the tractive power demanded during about one-third of the run to get the trains under way, is equivalent to the resistance of such a grade.

Thirdly, there is the effect of uncompensated curvature to increase the nominal grade of the profile, which sometimes exists and sometimes not, but which is well enough understood; and finally, there is the practical question of the strength of coupling and of the maximum length of trains which can conveniently be handled by one engine, which limits the length of trains on the very lowest rates of grade materially. For instance, there are several hundred miles of line in the United States which come very close to being virtual level grades, yet there is no road which attempts to handle trains of 2,675 tons or over 100 very heavy cars on them. Such trains are hauled in instances, and even larger one, but nothing approaching it it as a regular thing.

But this last exception applies only to the very lowest grades, and even on them chiefly because they are virtually much higher grades, as a result of curvature and stopping points. On all the ordinary working grades, after making proper allowances for the above specified causes, the table gives correctly the loads which ought to be hauled in daily practice in summer weather, because they are so hauled on many American lines. If they are not hauled, it is because the engines are not loaded up to their real capacity.

The table is based upon a rolling friction of 8 lbs. per ton and a ratio of adhesion of ¼. As to the former, although there is no doubt that the car resistance is often very much lower, and even the entire train resistance, engine and all included, yet there is as little doubt that a very moderate wind, or other unfavorable circumstances, will bring the resistance up to 8 lbs, and that engines cannot in practice be loaded to correspond to any lower resistance. As to the ratio of adhesion given, it can be now shown to be the regular working ratio of adhesion in American freight service by any amount of evidence, a large body of which is included in the volume from which we extract the table, and especially in the "Table 138" referred to in the note beneath it.

The table gives only the *adhesion* tractive power. The cylinder tractive power may or may not be as great, but in any well designed freight engine it always will be the greater at slow speeds of ten miles per hour or less. At much higher speeds, few or no freight engines have enough cylinder tractive power to utilize their full adhesion, and still less passenger engines, nor is it important that they should have, because no practicable boiler could furnish the necessary horse-power to utilize it.

That no higher ratio of adhesion than ¼ is used for computing the table, does not indicate that no higher exists. Experiment has clearly shown that it does; that on a good rail and with all conditions favorable ⅓ can be realized, and by the aid of sand about ⅖ can be realized under all conditions, when the speed is slow enough to give the necessary cylinder power. Trains have even been hauled in service which were only possible with ⅓ adhesion, but the working limit is ¼, and it is only within recent years that it has been as high as that. It is one of the indirect benefits of steel rails and tires, and certainly not the least.

The diagram beneath the table will greatly assist in making its substance clear. It is in part explained by an accompanying note, but we may add to that explanation the following:

The lines marked *A B C* indicate the loads corresponding to the ADHESION tractive power of the three engines tabulated at the side of the diagram, computed on the basis of one-fourth the weight on drivers.

The remaining lines indicate the CYLINDER tractive powers for the same engines at various points of cut-offs, as follows:

Engine *C*, 20 in. x 24 in., Consolidation, 48 tons on drivers. At half-stroke the cylinder power is somewhat less than the adhesion, and at 70 per cent. very slightly over. Only at very slow speed can such an engine furnish steam for running at 70 per cent. cut-off.

Engine *A*, 22 in. x 26 in, Consolidation, 50 tons on drivers, or 5 tons less than *B*, but indentical with in cylinder capacity, showing that the latter is in excess.

Engine *B*, 22 x 26 in. Mastodon, 55 tons on drivers. The two lines for cylinder tractive power apply alike to engines *A* and *B*. In both of these engines the cylinder power is much greater in proportion than in engine *C*, and cannot be fully utilized at one-fourth adhesion. As the working adhesion on a good rail often rises much higher than one-fourth, however, this surplus cylinder power is likely to be very useful in handling heavy trains easily, and indicates that engine *B* at least is better designed than engine *C* for the most efficient freight service.

Where and why tank engines are advantageous may be very clearly seen from this diagram as follows:

Referring to the head-lines to the large table it will be seen that the TOTAL weight of the lightest American engine and the WEIGHT ON DRIVERS of the heaviest Mastodon* are the same, 52 tons. A tank engine of the same total weight, all of it on drivers, while it will be a much lighter and cheaper machine than the Mastodon, and be equal to much lower speeds only, will have a greater net tractive power on all grades by the constant amount of 35 tons (saved in dispensing with a tender

*By "Mastodon" is meant a type of engine similar to the Consolidation except that it has a four-wheel in place of a two-wheel truck. The first engine of that type was named the "Mastodon," as was the first "Consolidation," and although it is not yet so generally recognized as the name of a type as "Consolidation" yet there is the same need for a distinctive name as before and there is every prospect that it will become so

and leading truck). Therefore, plotting on the diagram a line for 35 tons greater loads than for the upper heavy black line, we find that on the higher grades it makes an enormous difference in the percentage of net load hauled, but as the lower grades, below 2 per cent. (106 ft. per mile) are reached the two lines become almost coincident. This shows very clearly why tank engines are rarely used except on very heavy grades.

One further note as to the table given should be added. The table was computed three or four years since, and the sizes of cylinders given are rather large for the given weights, the tendency being to use heavier and heavier engines for the same cylinders. The approximate sizes of cylinders are only noted for convenience, however, the LOAD ON DRIVERS and the TOTAL WEIGHT OF ENGINE AND TENDER being the only locomotive details which enter into the computation of the table. On the whole, these are even yet not far out, but rather light; about right for a *half*-loaded tender. Every ton added to the engine means a corresponding ton off the net load; that is all.

PERSONAL.

GEORGE M. PULLMAN, the well known builder of cars, has been decorated by the King of Italy.

Capt. ADOLPHUS W. GREELY has been confirmed as Chief of the Signal Service Bureau.

JAMES J. TODD, of Palmer, Mass., has been appointed Assistant Roadmaster of the New London Northern R. R.

EMIL SWENSSON, late and Assistant Engineer on the South Penna. Railroad, is now connected with the Phœnix Bridge Co., in the Phœnixville, Pa. office.

Mr. JAMES HARRINGTON has been appointed Chief Engineer of the Cleveland, Akron & Columbus Railroad, with headquarters at Akron, O.

LYMAN ANDERSON is the engineer who will have charge of the construction of the new pipe foundry at Anniston, Ala.

LEWIS M. WOLFE, County Surveyor, died recently at Ashland, O. He had held the position for three years.

Mr. C. C. CHANDLER has been appointed Chief Engineer of the Ohio & Mississippi Railway in place of Mr. W. B. RUGGLES, resigned. Headquarters, Cincinnati, O.

The Dakota Railroad Commission, as recently appointed, consists of ALEX. GRIGGS, of Grand Forks, A. BOYNTON, of Lennox, and N. T. SMITH, of Huron.

JAMES ARKELL, ex-State Senator of New York, has been nominated by Gov. HILL to be Railroad Commissioner of New York, in place of JOHN O'DONNELL, whose term has expired.

Mr. R. H. TEMPLE is Chief Engineer of the Tennessee Midland Railroad, with W. A. HANKINS, H. A. WHITING, CABELL BRECKENRIDGE and A. H. BISHOP, as division engineers.

JEREMIAH FRUIN, the railroad contractor, whose murder in the Indian Territory was reported in the daily press last week, has telegraphed to parties in St. Louis that he is alive and well.

Mr. C. K. LAWRENCE has been appointed Engineer of Maintenance of Way of the St. Paul, Minneapolis & Manitoba Railway, with headquarters at St. Paul; and Mr. E. J. ROBERTS, Chief Engineer for construction of the line between Minot, Dak., and Great Falls, Mont., with headquarters on the work.

Col. GEO. E. Waring has been appointed Consulting Engineer to the City of San Diego for its sewerage works. His plans have been adopted with certain outlet modifications suggested by G. J. SPECHT, C. E. The amount of cash required is to be provided by $400,000 of 5 per cent. city bonds, having 20 years to run.

HENRY W. POTTS, formerly of Pottsville, Pa. Civil Engineer, has associated himself with A. W. MORRIS, Civil Engineer, of New York, and others in a company having for its purpose the mining of manganese ore.

JOHN C. LOOMIS will assume the duties of Assistant Superintendent of the Henderson Division of the Louisville & Nashville R. R. in conjunction with his present duties, that office having been discontinued. His headquarters will be at Evansville, Ind.

ADDIS EMMETT CARR, for a time on the Engineering Staff of the New Croton Aqueduct, died in Baltimore, Md, on March 1, aged 26 years. He was a grandson of the late Dr. J. Marion Sims and also of Mrs. David Dudley Field.

Major MCCALLA, Chief Engineer of the Georgia, Carolina & Northern R. R., has resigned to take charge of the railroad from Tuscaloosa to Birmingham, Ala. He has been succeeded by Capt. EXALL.

R. H. TEMPLE has been elected Chief Engineer of the Tennessee Midland R. R.; A. S. BUFORD President; T. C. LEAKE, Jr., Vice-President; R. L. TRAYLOR, Secretary and Treasurer. The office is at Memphis, Tenn.

WM. E. WORTHEN, President of the American Society of Civil Engineers, has been appointed by Mayor HEWITT, one of the five Rapid Transit Commissioners who are to study and report upon the proposed connection of the elevated railways of this city with the ferries on either river.

ALBERT E. EMERY, who has been seeking compensation from Congress for the Construction of the Waterbury testing machine, had $200,000 allowed him by the Senate bill. This sum the House reduced to $63,000, but the conference report, which was adopted by the House, fixed the amount at $100,000.

The revised bill died with the many others left unacted upon.

James Buchanan Eads.

JAMES BUCHANAN EADS, died of pneumonia at Nassau, N. P., on March 8. Mr. EADS was born in Lawrenceburg, Ind., May 23, 1820; at the age of 13 he went to St. Louis with his father, who was then in very humble circumstances. He early developed a love for mechanics, and began operations as a practical engineer by raising a cargo of lead from a sunken barge near Keokuk, using a whiskey barrel for a diving bell, In 1842, he organized a wrecking company which proved a great financial success, but five years later lost all his money in the manufacture of glass in St. Louis. He again entered the wrecking business, and in 1854 he was worth a half million.

On the breaking out of the Civil War he was commissioned by Attorney General Bates to prepare plans for war-ships to be used in opening the Mississippi river, and in two months furnished eight iron-clads carrying 107 guns. His great fame as an engineer dates from 1867 to 1874 in which time he built the St. Louis bridge with its 520 ft., arches and then phenomenal depth of foundations. The reputation there acquired enabled him to successfully accomplish his next great work, the improvement of the mouth of the Mississippi by jetties, though the work was commenced in defiance of strong opposition from government engineers.

Mr. EADS latest project, and one not yet quite assured, was the building of a ship-railway 134 miles long across the Isthmus of Tehuantepec to convey the largest vessels from the Gulf to the Pacific. Mr. EADS was a phenomenal organizer of men and means for carrying out great works, and a man of wonderful energy and resources. He was a Member of the American Society of Civil Engineers from date of Dec. 16, 1868, and had also been Vice-President.

The Ownership of Water.

Prof. ELWOOD MEAD, of Colorado, in a late address before the Farmer's Institute at Fort Collins, called attention to some of the weak points in the present laws of that state regarding the ownership of water. As one-fourth of the taxable value of Colorado comes from agriculture, and the value and productiveness of very much of the land depends almost wholly upon irrigation, anything which affects the water supply for this purpose, strikes at the value of the land itself. Under the laws at present all the water in a stream can be appropriated by anyone who builds a ditch; but this act of construction does not imply that the land to be irrigated necessarily belongs to the individual or corporation that builds the irrigation canal. The reverse is almost universally the case; and as the area to which it is possible to convey the waters of a stream very often is greater than the stream in question is competent to serve, the land owners are practically at the mercy of the owner of the water-right.

We have in water a direct gift from nature, in which all alike have ownership, and it is only permitted to become private property to secure a public benefit. Prof. MEAD does not think that this end is secured by simply passing it through a ditch; the benefit comes to the State and public from its application to the land. Major POWELL, in his work on the land system for the arid region, believes that "the right to use water should adhere in the land to be irrigated, and water-rights should go with land titles."

Prof. MEAD continued by stating that canal-building in Colorado was being overdone by rival corporations anxious to secure the use of water, and that this building was far in advance of settlement and the demands for water. The reasons given for the slow settlement of irrigated areas were that the high and variable charges for water and the iron-clad contracts of the ditch corporations prevented settlers from availing themselves of the supply; especially as the rate charge seemed to be based upon the value of the land irrigated rather than upon the actual cost of bringing the water to that land. Prof. MEAD thought that ditches should be made by law what they are in fact—common carriers. They should be endowed with the same privileges and rights but subject to the same responsibilities. The water-rate paid by the farmer should only represent a sum sufficient for the care and maintenance of the canal and a reasonable interest on the cost of construction. With this accomplished the speaker thought there would no longer be any necessity for expensive commissions to attract emigration; emigrants would come uninvited.

TECHNICAL NOTES.

MM. HENNEBEQUE and NEVE now propose to build a wooden tower 1,000 ft. high in connection with the Brussels Exhibition of 1888, to out do the proposed Paris tower of the same height, but of steel.

A WORKMAN employed in the United States Mint at Philadelphia, is said to have discovered a capital method of tempering drills. He drives the point of the drill at a cherry-red heat into a bar of lead, and the result is that a harder temper is produced than can be obtained by the acid bath.

GERMAN architects have been disputing the correctness of the supposition that mortar freezes at 26° F., below which point the police regulations of Berlin forbid its use. Herr KRAUSE says he has had excellent brick-work laid when the temperature was as low as 14° to 23° F. by simply slacking the lime in small quantities, and mixing the mortar hot; this work when torn down 24 years afterwards was found so firm that the bricks broke in attempting to separate them from the mortar. Herr KLEMM said that in Wurtemberg the general opinion was that frost improved rather than injured brick-work and plastering, if it was a continuous frost for say ten days.

A BILL is now pending before the Wisconsin Legislature, permitting grade-crossings to be passed without a stop if provided with interlocking signals and switches, including a derailing switch. The same sensible law, which directly tends both to economy and safety, is now in force in seven or eight States, and it is to be hoped soon will be in all. By electric locking, so that when one train is within limits on one track it is impossible to throw either the switches or signals right for the other track, the system is made absolutely safe, and even without it, it is safer than the ordinary crossing signals, with the stop.

THE wind derailments which occurred in Colorado on the night of Feb. 16 last are notable enough to record in detail, as follows:

On the Denver & Rio Grande Railway, four miles north of Colorado Springs, every coach of the north-bound

Salt Lake express, consisting of two sleeping-cars, two passenger coaches, and a baggage and mail car, was blown from the track.

A freight train of twenty cars, which was on a side track near by, waiting for the express to pass, was also derailed by the wind and the cars badly damaged.

The passenger train of three coaches which left the Union Depot on the Denver & South Park road for Morrison was lifted from the track by a terrific blast and hurled down an embankment when about twelve miles from Denver.

Near Como, on the same road, the Leadville express was blown over a bridge and nearly all of the passengers and trainmen were severely injured, and the coaches were badly wrecked.

A few days before, on the Denver, Marshall & Boulder Railroad, a train consisting of eighteen coal cars and caboose was lifted bodily from the track and thrown into a ditch at the side. The cars were empty, but flat cars, opposing little surface to the wind.

THE SUEZ CANAL.—The "train dispatching" on the Suez canal is handled from a single office thus:

"Against the wall at one side of the room is a narrow shelf or platform, along which runs a groove. At intervals this trough or groove has deep recesses, and at two places these recesses are of larger size, representing the sidings. When a vessel has been signaled and is about to enter the canal, a small toy boat or model, 3 or 4 in. long is chosen from a group which stands ready, each furnished with a flag. About forty have the English flag, ten or a dozen the French flag, and so on with other nationalities. As the steamer comes up and her name is known, it is written on paper and placed on the toy boat. As the telegraphic signals give notice, the toy boats are moved along, or placed in a siding, or shown traversing one of the lakes at full speed. The official who is on duty keeps the models moving as he receives notice, taking care when perhaps two ships going in opposite directions are both nearing the same siding to give timely warning to the pilots in charge by means of the signal balls and flags at each station under his control from the office, and to direct which of the two is to lie up and which to proceed. Barring accidents, the whole arrangement goes like clockwork."

IN answer to a query as to what would happen if his proposed 1,000 ft. tower in Paris should topple over, M. EIFFEL said that it was calculated to withstand a wind pressure of 61½ lbs. per square foot, counting the lattice work as full surfaces. He further remarked that in the event of a wind of this power sweeping over Paris, little would be left standing there—except the tower.

PROFESSOR CHANDLER ROBERTS has figured out that the weight of the smoke-cloud which daily hangs over London, may be estimated at 50 tons of solid carbon, and 250 tons of carbon in the form of hydrocarbon and carbonic acid gas. The Smoke Abatement Committee, from the average results of actual tests, calculate that 42 per cent. of the total heat generated from the 5,000,000 tons of coal burned annually passes away without being utilized; which figuring on actual coal wasted, haulage, etc., means a loss of about $13,000,000 per annum.

JAMES BURNS, of the Allegheny Valley R.R. shops, at Verona, Pa., is reported to have discovered the long-sought art of welding pure copper. This is accomplished by the use of unnamed chemicals, one heat and a hammer. The report is given for what it is worth.

THE Italian government is said to be building engines of 12,000, 20,000 and 25,000 horse-power respectively for war-ships now being constructed at Spezia and Castellamare.

"SECURITE" is a German invention for an improved, cheap, and efficient blasting powder, made out of the by-products of coke ovens and gas works. It is, weight for weight, more powerful than gun cotton, and very much cheaper than dynamite. It is in two forms, and the chemical composition of both may be thus described:—Its first form is a mixture of dinitrobenzene or trinitrobenzene with ammonium nitrate, and its second form either dinitronaphthalene or trinitronaphthalene with ammonium nitrate. The powder is granulated, of a light yellow color, with a smell like that of bitter almonds. When brought into contact with fire it burns, and, whilst burning, melts, giving out a yellow flame with little smoke. This flame is extinguished when the powder ceases to be in connection with the fire. No blows ignite it, and it can only be exploded with a 1,000 gramme cap, its effect being about four times as great as that of ordinary blasting powder. From a large series of tests it has been conclusively proved that *securite* may be safely exploded in the presence of fire-damp and coal-dust, and even when used where 10 per cent. of fire-damp was mixed with the most dangerous coal-dust no flame appeared. It can be safely carried from place to place, and the English Government has authorized its importation.

THE Cowles Electric Smelting and Aluminium Co., of Cleveland, O., are now exhibiting what they call aluminium steel. In a sample bar of iron welded to a bar of SIEMENS-MARTIN basic steel with one-fifth of 1 per cent. of aluminium added, no line of weld can be seen, the characteristics of the steel appearing to extend far into the iron. Without the aluminium, a clearly defined weld is visible between iron and the same steel. The same firm show a forged bar of aluminium bronze, with 5 per cent. of aluminium; this broke at 36 tons per sq. in. of original section, with 60 per cent. elongation.

THE patent for the Latimer retailing bridge safety-guard is owned by Mr. W. J. MORDEN of Chicago, Ill. (234 South Clark St.) We have already stated that we were in error in supposing that the patent had run out. Patent or no patent, we have nothing to take back of what we have said in its favor, and we understand that the royalty asked is far from high.

A LONG detailed statement of the present cost of mining coal in Luzerne Co., Pa., shows that it is for labor of all kinds $1.00 per ton on the cars, of which about 42 cts. is for miners wages, 21 cts. for miners labor, and the remainder for outside and miscellaneous labor. Royalty averages 25 cts., and the remaining expenses, apart from accidents of all kinds 13½ cts., making $1.38½ cts. in all. Profits are likewise not estimated, but if this estimate is correct, the colliery owners should be able to estimate them on a very satisfactory basis. These figures are usually kept very close.

THE firing trials of the new 110½ ton Elswick gun, intended for H. M. S. BENBOW, were commenced at Woolwich on February 10. This gun has the following dimensions:—Length over all, 524 in.; length of bore, 487½ in. (30 calibres) and 16¾ in. diameter. The maximum firing charge is 900 lbs. cocoa podwer; the projectile weighs 1,800 lbs.; the estimated muzzle energy is 2,216 ft. per second; and the estimated total energy is 61,200 foot-tons. The first round was fired with 598 lbs. of powder with an 1,800 lb. projectile; the muzzle velocity was 1,685 ft. per second, and the projectile "entered 52 ft. into the butt." The steel shell used is 54.9 in. long by 16.19 in. extreme diameter; the bursting charge is 179 lbs. of powder. A schrapnel shell is also supplied of similar dimensions and weight, which carries 2,300 4-oz. ball and an 8 lbs. bursting charge. The armor-piercing projectile is made of forged steel containing from 1 to 2 per cent. of chromium.

THE Massachusetts census for 1885 shows that the population was:

1875.	1880 (U. S.).	1885.
2,651,912	1,783,085	1,942,141
Increase p. c.	7.95 p. c.	8.92 p. c.
Total gain, 1875-85		17.57 p. c.
" " 1865-75		30.38 p. c.

The curious fact is developed that the center of population is within a mile of the Boston State House, while the center of territory is near Lake Quinsigamond, inside the Worcester City limits. Within eight miles of the State House is almost 30 per cent. of the whole population of the State, and within twelve miles, 37.08 per cent. Of the total population, 56 per cent. is in the twenty-three cities, and in the ten years the cities have gained 23.66 per cent. of population, and the towns 10.64 per cent. In density of population only Rhode Island is ahead of this State. In 1880 the former had 254.9 people to the square mile, and the latter 221.8 in 1880, and 241.56 in 1885. New York had 106.7 in 1880. Only the most densely populated of the old countries surpass this State, those with a more compact population being Belgium, with 481.71; Great Britain and Ireland, with 289.92; British India, with 311.57; Italy, with 234.28; and the Netherlands, with 312.86. Were the entire United States as densely populated as Massachusetts it would contain the sizeable population of 720,000,000.

The most momentous and striking fact, however, is the increase of *thirteen months* in the average age of the population, or from 27 years, 8 months to 28 years, 9 months. A more convincing testimony to the effect of recent sanitary progress and the greater well-being of the average man could hardly be, for it will be seen at once that it indicates an average age for the entire population *of* 136 *years* within the brief period of ten centuries, or a doubling of the average age in 360 years. Nearly all the change is in infants under 20 years of age. For those over that age the average has only increased from 40 years 7½ months to 40 years 9 months.

Snow Removal in Paris.

Mr. H. VIVAREZ, in concluding his article for *Engineering* on "Street Cleaning in Paris," says that it is only since 1870 that exact regulations have been made fixing the relative shares of the city and inhabitants in the removal of snow and ice from the streets. The snow is heaped up by individuals and the scavengers and the removal is done by contract at a price per cubic metre. By its charter the *Compagnie des Omnibus* is obliged to furnish 50 carts with two horses each for this service. The price paid is fixed for each section in accordance with the length of haul to point of discharge; and the quantity arrived at either by an estimate of the heaps or the cart capacity.

When a thaw takes place the hydrants are opened, and both hand and machine brushes used to sweep the melted snow into the sewers. In 1879-80 M. D'USSEL initiated the use of salt on the occasion of the very unusual fall of 10 to 14 in. of snow (for further particular see ENGINEERING NEWS (Vol. XVI.) He treated 210,000 sq. yds. of roadway with 55,000 lbs. of salt with excellent results; the salt is scattered by a man from a barrow, and for a snow of 1½ to 2 in. deep, about 0.37 lbs. per sq. yd. is provided for. If the thickness amounts to 6 or 8 in., the application is made twice, the surface snow being removed between the two. The tram companies also salt the streets traversed by their lines. With salt costing about 2 cents per pound (as at the time of the experiment in Paris, including *octroi* and State dues), the expense of applying the amount named above, was about 0.74 cts. per sq. yd.; this was about one-half the cost of sanding the streets of Paris.

An attempt to substitute for salt the cheaper chloride of calcium was abandoned, owing to its acid reaction, and the fact that it stained the garments of pedestrians. From Dec. 8, 1885 to Jan. 25, 1886, snow fell seven times, four times to a depth of 4 in. Thanks to salting, the snow in each case was removed the same evening, and traffic was uninterrupted. The salt used amounted to 1.7 per cent. of the snow by weight. The actual expense for snow removal in the month of January, 1886, by salt was $71,300, whereas by the ordinary method without salt it would have cost in Paris more than $300,000.

PUBLICATIONS RECEIVED.

Shoppell's Modern Houses, No. 5. Large folio. 72 pp. Containing 49 Designs for houses and other buildings 191 Broadway, New York. $1.00.

Analysis of Rotary Motion as Applied to the Gyroscope. By Maj. J. G. BARNARD, A. M.. No. 90 of Van Nostrand's Science Series, New York; 12 Mo. 66 pp. 50 cts. A reprint of an article written in 1858, by Gen. BARNARD, and still perhaps the best analysis of this abstruse mechanical problem.

Internal Commerce of the United States.—Report of WM. F. SWITZLER, Chief of Bureau of statistics, U. S. Pub. Doc. pp. 738; 4 plates.

This volume is almost wholly confined to a well justified glorification of the industrial progress of the south. It is very verbose, a separate expert having reported on each southern state, but the report truly says of them that they are "a study, a lesson, and a revelation". The plates, showing the reduction in rates on the southern railroads, are especially striking, showing as they do that rates have fallen as fast then as in the rest of the country.

Record of Transportation Lines Owned and Operated by and Associated in Interest with the Pennsylvania Railroad. Compiled from Official Data on File in the Office of the Chief Engineer of Philadelphia. Dec. 31, 1886.

This perfect model of an abstract of information as to track of a vast system covers 4,154 miles of road and 397 miles of canals and ferries east of Pittsburg and

Erie, and 7,404 miles in all, on which there are 11,720 miles of track. It gives for each line or branch separately the mileage by States; the amount of first, second, third and fourth track, company sidings and private sidings: and the exact location and character of each crossing of another road (over, under and grade) and of each junction point. We have noted elsewhere some facts from the record.

The March "Outing."—THOMAS STEVENS and his wonderful trip around the world on a bicycle, are on the lips of thousands—not merely those who ride the wheel of steel, but all who admire courage and daring. The March *Outing* contains the continuation of this remarkable series, illustrated by the distinguished artists, J. & C. TEMPLE. STEVENS, though he finished his trip only a few weeks ago, has barely got through the capital of Persia in the number before us.

A variety of articles on outdoor life and sport make up the remainder of the number. We may mention among the subjects treated: Bicycling in Virginia and New Hampshire; Life in Southern California; Rowing; Carnival Sports in Rome; a splendid Sea Yarn by CAPTAIN COFFIN; Trout Fishing in Germany; Bear Hunting in Mexico; Snipe Shooting on the Prairies; Canoe Cruising in Florida, etc., etc., etc. The monthly record as usual, gives a complete review of the sports of the past month.

Cable vs: Horse Railways.

THE *Philadelphia Press* gives quite an elaborate discussion of the comparative economy of cable and horse railways, and figures out a very considerable excess of profits for the cable. The great advantage of the cable system lies in the ease of adjustment of carrying capacity to traffic demands, says the *Press*, and to prove its position, the following tables are given:

COST OF THE TWO SYSTEMS.

	Comparison of Cost and Earnings of a Horse and a Cable Road Three Miles Long.		Comparison of Cost of Doubling the Carrying Capacity of Same Road.	
	Horse.	Cable.	Horse.	Cable.
Passengers required to pay daily operating expenses	7,144	3 754	14,241	5,550
Time to pay daily operating expenses	13½h.	7h. 7m.	1⅔h.	5¼ h.
Cars to pay daily operating expenses	325	171	648	253
Yearly operating expenses per mile	$21,730.70	$11,418.00	$43,149 33	$16 880 66
Total operating expenses	130,364.00	68,508.00	258,896.00	101 284.00
Yearly net earnings per mile	7,177 12	17 489 5-	14 500.23	40,937.75
Total yearly net earnings	43 062.70	104,937 50	87,001.40	245,608.50
Total cost, equipment and roadbed per mile	15 333.33	54,033 33	25,406.66	57,233.33
Ratio of net earnings to total cost	46.8 p. c.	32.4 p. c	55 9 p. c	71.5 p. c.

PROFITS OF THE CABLE.

	No. 1.		No. 2.	
	Horse.	Cable.	Horse.	Cable.
Speed per hour	4½	6	4½	6
Working hours	18	18	18	18
Number of cars	32	12	64	64
Single cars daily	432	216	864	432
Passengers per trip	22	44	22	44
Passengers carried daily	9 504	9 504	19,008	19 008
Gross earnings daily	$475 20	$475.20	$950 40	$950 40
Op. expenses daily	357 22	187.70	712 40	277 50
Net earnings daily	117.98	287.50	238.36	672.90
Op. expenses to gross earnings	75.2 p. c.	39.5 p. c.	.75 p. c.	29.2. p.c.

The above tables speak for themselves, and are said to be submitted by an expert in the subject and as gathered from personal experience and official sources. The "traction bosses" of Philadelphia, however, seem to think differently, judging from their vigorous efforts to maintain present traffic rates in that city, whereby, as one of the city papers puts in, the passenger may continue to pay "6 cts. for a 5 ct. ride on a 4 ct. car.

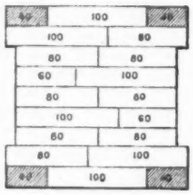
Poughkeepsie, N.Y.—The Water Commissioners have submitted their report for 1886, being their eighteenth annual report. The efficiency of the filter beds had become so impaired by the clogging of the material, owing to uninterrupted use since 1872, that the water became discolored; the beds were therefore thoroughly cleansed and put in good condition, and a method of cleaning has been put in operation which will prevent further trouble. The water waste has assumed serious proportions. During the year 47 taps have been put in and 76 meters; the meters in use are Worthington, Crown, Empire and Equitable, with one elevator meter; four hydrants have been put in and there are now 315 on the distribution mains; 1,802 ft. of 9-in. pipe were laid and 60 ft. of 4-in. hydrant branches; seven 6 in. gates were put in. The sewer work done comprises 133 ft. of 15-in. pipe, 360 ft. of 12-in. pipe, 82 ft. of 10-in. silt basin connections, 67 ft. of 6-in. drain basin connections, three silt basins, one drain basin and five manholes; the work was done by Cook Bros., under contract. The total consumption for the year was 634,493,720 gallons, 43,000,000 in excess of last year; 1,900 families are supplied. The report of CHAS. E. FOWLER, Superintendent, contains interesting information respecting the cleaning of the filter beds, etc.

The Manufacture of Rolled Beams in Belgium.

The following notes upon the manufacture of rolled beams in Belgium is an abstract from Paper No. 2,207 in the Selected Papers, Institution of Civil Engineers, and comes originally from a paper in the *Annuaire de l'Association des Ingenieurs sortis de l'Ecole de Liege*, vol., v. p. 123.

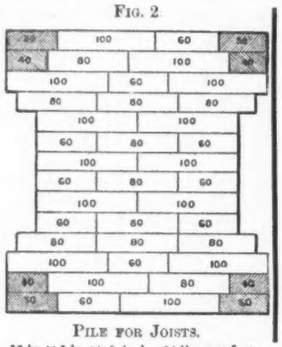
The present annual output of rolled beams in Belgium is about 120,000 tons, and the author of the paper takes as a typical instance, an establishment with two blast-furnaces, each capable of turning out 100 tons of iron per day, and a rolling mill able to produce 2,700 tons of rolled beams per month. The iron used is almost exclusively made from the oolitic iron ore of the Grand Duchy of Luxembourg, which contains in its raw state from 0.53 to 0.90 per cent. of phosphorus, but only some 0.03 per cent. of sulphur; this is used with a dose, amounting to from 25 to 30 per cent. of the total charge, of "mixed slag" composed of slags from the puddling and reheating furnaces in about equal proportions.

FIG. 1.



PILE FOR JOISTS.
7 in. × 2½ in. × ½ in.
10½ lbs. per foot.
Scale ½.

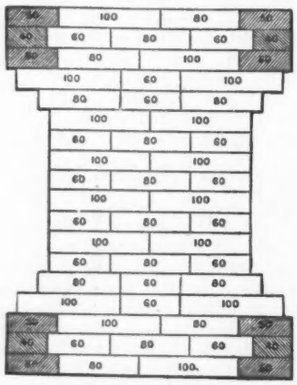
FIG. 2



PILE FOR JOISTS.
12 in. × 5 in. × 1/16 inch. 34 lbs. per foot.
Scale ½.

The blast-furnaces have a total height of 65 ft. 7 in.; diameter at bosh 16 ft. 5 in.; at throat, 13 ft. 1 in.; at bottom of hearth, 6 ft. 7 in. The coke used costs $2.45 per ton; and the net cost of the pig produced is $7.01 per ton. The net cost of puddled bar per ton is $12.51; and of fagoted bars (No. 2 iron) it is $17.52. The net cost of first and second class beams (Belgian specifications), rolled on the 20-in. train, is $19.06 per ton; for third class, rolled on the same train, it is $19.54; the average net cost per ton of rolled beams, from the first to the eighth class, $18.96. The average waste of the piles in the furnace is about 12 per cent., and that from wasters and croppings is about 4.7 per cent.

FIG. 3



PILE FOR JOISTS.
16 in. × 6 in. × ½ in. 57 lbs. per foot.
Scale ½.

Figs. 1, 2 and 3 show the piles as built for beams of the dimensions given; they weigh 10½ lbs., 34 lbs. and 53 lbs. per lineal foot respectively. The shaded parts in each denote the proportion and arrangement of No. 2 bars, with the dimensions in millimetres.

The original paper, which is lengthy, contains exhaustive particulars of manufacture, tables of wages, current and incidental expenses in each department; and also details of coke ovens, sections of blast-furnaces, examples of piling and form and draught of rolling grooves.

SOCIETY PROCEEDINGS.

Engineers' Club of Philadelphia.—At the regular meeting, Feb. 19, Prest. CLEEMANN was in the chair and 34 members and 1 visitor present. Mr. JOHN FERNIE, M. INST. C. E. etc., delivered an address upon. *The Mechanical Genius and Works of the late Sir Joseph Whitworth* which was most interesting in its details and consumed the entire evening.

Engineers' Club of St. Louis.—Meeting of March 2, 1887. President Potter in the chair, 24 members and 3 visitors present. ALEX. E. ABEND, CHAS. F. MULLER, MAX G. SCHINKE and LEWIS STOCKETT were elected Members.

ROBERT MOORE read a paper on the *Present Aspects of the Problem of Inter-Oceanic Ship Transfer.* A history of the various schemes which had been made public was given, as well as the results reached and the difficulties yet to be met. At present the question had narrowed down to three prominent routes, each of which has its supporters. The De Lesseps Panama Canal was discussed at length, the present condition of the work noted, its cost thus far, and the amount necessary to finish it shown. This, as well as the grave engineering difficulties to be solved, and on which the success of the work hinged, led the speaker to believe its completion impossible and its early collapse probable. The second scheme, known as the Tehuantepec route, was for topographical reasons not available for a canal, but has been chosen by Capt. JAS. B. EADS for his ship railway. This plan was also discussed at length, and its advantages and disadvantages considered. The great first cost, the cost of operating, and the serious and as yet unsolved engineering difficulties to be met, seemed to throw the preponderence of evidence against the enterprise. The third scheme was that known as the Lake Nicaragua Canal, which so far has not been as prominently mentioned as the others. While its first cost is undoubtedly great, it is not so large as either of the others, and its operating expenses would be much less. The work was of great magnitude, but yet of a character which had already in many instances been successfully handled, and in the whole route nothing new or untried would be met. On the whole, the speaker believed the Nicaraguan scheme the one which best deserved the recognition and support of the American people. The paper was discussed by Messrs. POTTER, SEDDON, MCMATH, H. C. MOORE, and OCKERSON.

American Society of Mechanical Engineers.—By a resolution of the Council, pursuant to the request and suggestion of a large number of the members, the XVth Meeting of the Society will be held in the City of Washington, D. C., about the middle of May, 1887. The exact date and further details will be the subject of later announcements.

Papers for this meeting must be in the Secretary's hands before March 25, and titles should be sent on at once. It may be mentioned that fewer papers than usual have been so far contributed and promised, and the obligation is urged upon every member to see that our transactions are not allowed to deteriorate in value from this inaction. Topics are also solicited for the topical discussions at once. The Secretary will be glad to correspond immediately with members who have subjects to present. F. R. HUTTON, *Secretary.*

Association of Provincial Land Surveyors of Ontario, Canada.—The second annual meeting of this association at Brockville, Ont., March 1 and 2, was attended by over 50 members, etc. Mr. WILLIS CHIPMAN, the Secretary-Treasurer, reports a total membership of 90, with continual additions and a very live interest in the association apparent.

De Land, Fla.—The City Council are writing to all contractors whose names can be procured, with reference to the construction of water-works. It is desired to grant a franchise to some one to put in the works. The population is estimated at 2,200. For further information address SILAS B. WRIGHT, City Clerk.

CONSTRUCTION NEWS.

Water.

Highmore, Dak.—The artesian well began flowing at 1,550 feet.

Chatham, Canada.—The town of Chatham, Ont., is agitating for a system of water-works and the question of filtration is being considered. JOHN H. LUSCOMBE is interested.

Philadelphia Water Department.—Councils on March 1st resolved to appropriate $100,000 for the completion of one section of the East Park reservoir; $170,000 for new 30-in. supply mains from Wentz Farm reservoir, and $30,000 for completion of mains commenced last week.

The South Mountain Water Co.—The Philadelphia City Councils are having some lively discussions over the proposition of the South Mountain Water Co. to supply that city with water as a private corporation under terms which we have before referred to. The latest phase is a threat from its advocates that the people can force an issue in the courts on the head of a present bad supply. All decision is postponed for the present.

Brockton, Mass.—On Feb. 28, at the State House, Boston, the Committee on Drainage continued the hearing on the petition of the city of Brockton for leave to take land in Easton to dispose of its sewage. Mr. C. H. SWAN, Mr. ELLIOT C. CLARKE, and other sanitary engineers, testified in behalf of the city that such a sewage field, properly arranged, would not create a nuisance.

Allentown, Pa.—The Water Commissioners have issued their report for 1886, being their twelfth annual report. The commissioners have extended the mains and replaced lines with mains of greater diameter: 1,443ft. of main were laid and 5,719 ft. relaid; 33 stop valves were set. It is stated that the dam at the pump house is in a filthy and marshy condition and very obnoxious to health, but the pumps cannot be stopped to permit drawing off the water for cleaning, as the city would be without water for several days. The commissioners will shortly submit a plan to the Council for the remedying of all these defects. SAMUEL S. THOMPSON is Superintendent.

Wilmington, Del., Sewerage.—Members of the Wilmington Board of Trade think that Col. Waring's proposition of $6,500 per mile for 6-in. pipe laid 6 ft. deep is too high. They say that the city authorities are now laying 12-in. pipe-sewers 8 ft. below the surface for $3,432 per mile. The bulk of the opposition to Col. Waring's plans undoubtedly comes from the nine private sewerage companies now incorporated and at work there. These companies depend entirely upon the necessities of the citizens to induce them to connect with their systems when laid; there is no compulsion by city enactment at all.

Chicago Drainage.—Mr. Rudolph Hering, Engineer in Chief of the Commission, has been explaining the plans for the proposed new drainage of Chicago to the Joint Committee of the Senate and House of the Illinois Legislature, which were appointed to investigate ultimate effects on country south of Chicago. Mr. Hering said that the ditch from the Chicago river to Joliet would have sufficient capacity to carry off the diluted sewerage of Chicago and also drain the flood waters of 130 sq. miles of adjacent territory. It would be 200 ft. wide by 18 ft. deep; with a capacity of 10,000 cu. ft. per second, or a velocity of 2 miles per hour. The dilution would be equivalent to 18,000 cu. ft. of water per minute to every 100,000 inhabitants.

New Water-Works.—Sherburne, N. Y. The mains have been extended to a hamlet called the Quarter.——Green Island, N. Y. The works which have been contracted for will be built shortly.——Mansfield, Mass. Water-works will be established this year.——Lebanon, Mo. Drilled wells are to be put down and a system of water-works established; a company has been organized and contractors have been invited to bid for drilling the wells.——Macon, Ga. The Macon Gas & Water Co. will extend and improve its system.——Pecos City, Tex. Artesian wells are to be put down, address Capt. F. B. CHILTON.——Kirkwood, Mo. The water-works enterprise is being revived and new surveys have been made; the movement contemplates a supply for Kirkwood, Webster and the stock yards from the Meramec river.——Waseca, Minn. Water-works bonds for $6,000 will be issued.——Punxsutawney, Pa. Of the $15,000 required for water-works $12,000 have been subscribed.——Helena, Mont. A charter for water-works has been granted to GEORGE F. WOOLSTON, of Boston.——Ashtabula, O. Work will be commenced in April; trial wells have been dug; Col. LOCKETT is chief engineer.——Drownsville, R. I. A water supply is contemplated, either from the Barrington Water Co's mains or an independent source.—Tullahoma, Tenn. Water-works are to be established; work will be commenced soon.——Manor, Tex. Works will be established.——Washington, Ia. Address the Mayor with regard to water-works.——Southern Pines, N. C. Address P. POND.

Allegheny, Pa., An ordinance has been adopted authorizing the issue of $100,000 city water bonds for extensions and improvements.——Larned, Kan. Work on the city works was commenced March 3.——Michigan City, Ind. An election on improving the water-works resulted in a favorable majority of 753.—Escanaba, Mich. A large in-take pipe is being laid, extending 2,500 ft. into the bay.——Hingham, Mass. Improvements in the water supply system are recommended.——Hiawatha, Kan. All the bids for the $50,000 water-works bonds were rejected, and the bonds were sold by auction to the First National Bank, of that city, at 98 cts. on the dollar.——Whitman, Mass. An appropriation of $3,000 has been made for continuing the experiments on the well system for a water supply.——Claremont, N. H. Manchester parties have offered to put in works, agreeing to sell the system to the town for $40,000 within two years.——Huntsville, Ala. The works being enlarged.——Salem, N. C. The works are to be enlarged.——Pasadena, Cal. The water system will be relaid at a cost of $15,000.——Stockton, Kan. Bonds for $30,000 have been voted for water-works.——Du Quoin, Ill. W. B. HALL is interested.——Knoxville, Ia. I. H. GARBETTSON and E. R. HAYS are interested.——Farnumville, Va. Address A. D. WATKINS.——Freehold, N. J. Address W. H. FORMAN.——Baton Rouge, La.——Live Oak, Fla.——Delaware, O.

Water Companies.—Gilman Water-Works Co., Gilman, Col.; GEORGE J. CAME, ANGUS MCDONALD and others; capital stock, $40,000.——Pecos City Water Co., Pecos City, Tex.; Capt. F. B. CHILTON, president.—North Easton Village District Water Co., North Easton, Mass.; FREDERICK L. AMES and others; to take water from the Quexet river.——Marion Water-Works Co., Marion, Kan.; W. A. SANFORD, S. T. HOWE, of Marion; capital stock, $100,000.——Lamar Water Co., Lamar, Col.; T. DIXON PRICE, FRANK P. ARBUCKLE and FRANK H. SHROCK; capital stock, $75,000.——Skowhegan Water Power Co., Skowhegan, Me.; G. S. KERNE, Lynn, Mass., is interested.——City Water Co., Chattanooga, Tenn.; J. S. KUHN, president; $200,000 bonds to be issued for improvements; (a consolidation of the Lookout Water Co. and the Mountain Spring Water Co).——National Water Supply Co., Cincinnati, O.; capital stock, $60,000.——Milford Water Co., Milford, Mass.; will increase the capital stock to $200,000.

Cullman Water Co., Cullman, Ala.; J. H. KARTER, Secretary.——Florence Water Supply Co., Florence, Kan.; A. F. HORNER and others.——Eufaula Water Co., Eufaula, Ala.; capital stock $60,000; S. H. DENT, President, E. B. YOUNG, Secretary; machinery, stand-pipe and mains will soon be wanted.——Clarion Water Co., Clarion, Pa.——Jamestown Water Supply Co., Jamestown, N. Y.; S. B. BROADHEAD, President; a new and pure water supply is to be obtained.——Verdigo Springs Water Co., Los Angeles, Cal.; capital stock $66,000; E. M. Ross.——Greenbush Water Works Co., Greenbush, N. Y. Capital stock increased from $150,000 to $250,000.——Green Island Water Works Co., Albany, N. Y. Capital stock increased from $60,000 to $125,000.——East Dallas Water-Works Co., Dallas, Tex., Capital stock increased from $25,000 to $50,000.——A water company has been organized at Lebanon, Mo.

Simple Water Tests.—*Test for Hard or Soft Water.*—Dissolve a small quantity of good soap in alcohol. Let a few drops fall into a glass of water. If it turns milky, it is hard; if not, it is soft.

Test for Earthy Matters or Alkali.—Take litmus paper dipped in vinegar, and if, on immersion, the paper returns to its true shade, the water does not contain earthy matter or alkali. If a few drops of syrup be added to a water containing an earthy matter, it will turn green.

Test for Carbonic Acid.—Take equal parts of water and clear lime water. If combined or free carbonic acid is present, a precipitate is seen, to which, if a few drops of muriatic acid be added, an effervescence commences.

Test for Magnesia.—Boil the water to a twentieth part of its weight, and then drop a few grains of neutral carbonate of ammonia into a glass of it, and a few drops of phosphate of soda. If magnesia be present it will fall to the bottom.

Test for Iron.—(1.) Boil a little nut-gall and add to the water. If it turns gray or slate black, iron is present. (2.) Dissolve a little prussiate of potash, and, if iron is present, it will turn blue.

Test for Lime.—Into a glass of water put two drops of oxalic acid and blow upon it. If it gets milky, lime is present.

Test for Acid.—Take a piece of litmus paper. If it turns red, there must be acid. If it precipitates on adding lime water, it is carbonic acid. If a blue sugar paper is turned red, it is a mineral acid.—*Invention.*

Memphis Drainage.—City Engineer Meriwether, of Memphis, Tenn., has lately given a condensed report of the Waring sewerage system in that city over which there is now some discussion and adverse criticism. The population is about 60,000, with 43.43 miles of sewers, 4 miles of which are mains discharging into the river. The mains are 10, 12, 15 and 20-in. diameter; about 85 per cent. of the laterals are 6-in. pipes; the mains are generally laid with a grade of 2 ins. per 100 ft. as a minimum; the minimum grade on laterals is 6 ins. per 100 ft. At the upper end of each lateral is a Roger Field automatic flush-tank, discharging 112 galls. of water in 40 seconds, usually acting once in 24 hours. No surface or roof-water admitted, the system being proportioned for house sewerage only. The house-drains are 4-in. diameter, with no traps on the main drain but a separate trap on each fixture. The soil-pipes are cast-iron, with lead joints and extend 4 ins. above the roof. Each lateral trench is laid with agricultural drain-tile to carry water to the bayous. 36.6 miles of this subsoil drain being in use. The trenching was done by contract, but the pipes were laid by hired labor. The last prices paid for excavating and back filling were as follows:—Per lineal foot, trench 6½ ft. deep, 25 cts.; 6½ to 9 ft., 30 cts.; 9 to 12 ft., 45 cts.; 12 to 15 ft., 75 cts. The pipe-laying, including laying of drain-tile in same trench, cement, sand, oakum and tile-paper, is estimated to cost 7½ cts. per lineal foot. The flush-tanks cost $45 each, including $10 royalty. The 6-in. pipes, though in some cases draining for 3,000 ft., have never been overcharged. No trouble has been caused by sewer gas; and while some of the pipes have been obstructed by sticks, etc., the average cost of removal was $13.50 each. Deposits in the mains have been promptly removed by passing a hollow metal ball though them of 3 in. less diameter than the pipe. Pipe-laying was commenced Jan. 20, 1880 and by July 1, 1880, 20 miles were in place. Mr. Meriwether concludes by saying that "the system of sewers appears to give entire satisfaction both to the city government and citizens generally."

Montclair, N. J.—The contract between John R. Bartlett and the Township Committee, by which the former undertakes to establish a water supply system, has been signed this week. A reservoir will be built between Garret Rock and Great Notch, near Paterson, N. J., and pipe laying will be commenced next month. It is stated that the water will be supplied by Aug. 1.

St. Louis, Mo.—In June $3,500,000 water-works bonds will be taken up, and after that the net earnings of the works may be expended on improvements. The Board of Public Improvements has prepared bills for a pumping station at the Chain of Rocks, with a conduit seven miles long to the basins at Bissell's Point, and for a temporary pumping plant at the low service pumping station, at a cost of $45,000. Neither bill has been considered, the council being of opinion that the capacity of the works is ample for two or three years. COL. FLAD, M. Am. Soc. C. E., the Commissioner of Public Works, believes there is danger of a water famine next summer and urges that steps be taken at once to increase the capacity. There has been considerable complaint lately of the muddy condition of the water, and COL. FLAD has been experimenting with filters.

Calais, Me.—The pumping station is equipped with two pumping engines manufactured by the Geo. F. Blake Co., of New York City; one is a duplex, compound condensing engine with a daily capacity of 2,000,000 gallons, the other is a high pressure engine with a daily capacity of 1,000,000 gallons; there are also two boilers 54 inches diameter and 17 feet long. The water flows by gravity from the filter crib in the river to the suction well. The reservoir, which has a capacity of about 3,000,000 gallons, is located on Todd's mountain, in Milltown, N. B., about 1.25 mile from the pump house. Its elevation is 222.5 feet above high water in the St. Croix river at Calais. The pipe system comprises about 24 miles of pipe, and includes the city of Calais, Me., and the towns of St. Stephen and Milltown, N. B. The smallest size of main is 6-in. diameter. There are 165 gates; 83 hydrants in Calais, 45 in St. Stephen and 30 in Milltown; the hydrants and gates were supplied by the Chapman Valve Co., of Boston, Mass. There are at present 170 services, and the pumps are worked two days per week. The contractor for the entire work was James J. Newman, of Providence, R. I. The engineer in charge of consrtuction was H. G. DENNIS, of New Bedford, Mass., and M. M. TIDD, of Boston, Mass., was consulting engineer.

Kansas City Work for 1886.—City Engineer DONNELLY, of Kansas City, has just submitted his report of work done in the last year. The total amount expended on public works was $545,756; in this sum $277,216 was expended on new paving; $40,610 on new city sewers and $65,486 on new district sewers; $12,057 was spent on bridges. A new viaduct is contemplated from Fourth St. westward, to cost about $50,000; another viaduct is needed across the Belt R. R., estimated at $48,500. In only four of the 21 paving contracts was a concrete base used under the cedar blocks; Mr DONNELLY thinks it would be better to found them all on concrete, 6 ins. of this having been proved to be sufficient under the heaviest traffic. Cedar blocks have stood well. The sewers built in the year amounted to 7.36 miles; to present date the average cost of all the sewerage system is $3.76 per

lineal foot, with 50.35 miles built. During 1886 the water works company spent over $500,000 in changing the source of supply from the Kansas to the Missouri river. At Wyandotte a four-chambered settling basin of 50,000,000 gallis. capacity is nearly finished. The capacity of the new works will be 20,000,000 galls. daily, with provisions also nearly completed for doubling this. The works will be in operation by June 30, next. There are now 74.35 miles of water mains laid in, total and 754 hydrants.

Railroads, Bridges and Canals.

Chicago Ship Canal.—City Engineer ARTINGSTALL has prepared estimates for a canal from the south branch to the lake; it will be 12,200 ft. long, 200 ft. wide and 18 ft. deep. The cost of excavating, etc., for the canal itself is estimated at $1,923,450; land, $2,421,295; roadway swing bridges, $800,000; railroad bridges $350,000. Total cost, $5,494,745.

East River Bridge or Tunnel.—At Albany, N. Y., a bill has been introduced by Assemblymen FARRELL, to authorize the appointment of a commission by the cities of New York and Brooklyn to consider the feasibility of a means of transit across the East river by bridge or tunnel from Broadway, Brooklyn, to Grand street, New York; the commission to report to the State Legislature on or before April 10.

Macon Canal.—A company made surveys a few years ago for a canal from the Ocmulgee river above Macon, Ga., to a point below the city, for the utilization of the water power. The matter is again being agitated and new surveys will be made shortly. The estimated cost is about $3,000,000, and power would be furnished to numerous factories.

York Harbor & Beach R. R.—This is a new line being built from Kittery station on the Boston & Maine R. R., to York Beach, Me., a distance of 11 miles; the road is standard gauge and is to be in operation by the end of July. Contracts for six miles were let this week. GORHAM P. LOW is Engineer, and H. BISSELL, Consulting Engineer.

Atlantic Coast Canal.—It is reported that the Atlantic Coast Canal Co., of Florida, has cut through from the Matanzas river into the Halifax river and into Mosquito inlet; a channel has also been cut through the rocks at the mouth of the inlet into the Indian river. The dredges will soon be removed to the Indian river narrows and afterwards to the Jupiter narrows.

Elevated Tracks for Jersey City.—At the meeting of the Board of Aldermen of Jersey City, N. J., the question of the proposed elevation of the tracks of the Pennsylvania R. R. was discussed. Messrs. Earle & Harrison, surveyors, submitted plans in support of the claims in opposition to the scheme, showing the street alterations, etc., and stress was laid upon the great expense to the city of these alterations. The matter will again come up for consideration on March 15.

Union Elevated R. R.—Work has been commenced on Flatbush avenue, Brooklyn, and the road will now be pushed to completion. The section from Atlantic avenue to Fulton street will be built first, and by the time this is completed it is expected the decision of the court will have been rendered and the company will decide whether to build down Fulton street or Hudson avenue. It is intended to have the line from Atlantic avenue to the Brooklyn bridge in operation for the summer traffic, and the line beyond Atlantic avenue to Greenwood will probably be finished within a year.

Kansas City Cable Roads.—Chief Engineer KNIGHT, of the Metropolitan Street Railway Co., says that two miles more of double track cable-road are to be built at once on the Wyandotte extension, and four miles of cable on the Twelfth St. line; the contracts for the first are let and the machinery will be up in about 6 weeks. The bridge over the Kaw and an iron viaduct over one-quarter mile long will be finished May 1: the Kansas City Bridge Co. will erect the superstructure for $42,000. The company's car-house will be 200 ft. square and cost $50,000. Mr. KNIGHT said that they expected to have the whole line in operation by Dec. 1 next; and by putting 1,000 men at work, he expected to lay 2,500 ft. of track complete per month, and the labor bills alone would amount to $450,000 in the year. Chief Engineer BONTECOU, of the Grand Avenue cable line, says that 5 miles of line have been contracted for; the masonry on the new bridge is finished, and he expects the line to be in operation by June 1.

Fort Worth & Denver City R. R.—The company has recently purchased the Denver, Texas & Gulf R. R., which is a link in the line from Denver to the Gulf. With the exception of 250 miles from Savannah to the Texas State line, the F. W. & D. C. R. R. is completed; work on this line is in progress under the construction company of which Gen. Dodge is the president, and when finished the 200 mile line from the Texas line to Pueblo, Col., will be built. It is stated that the line will be opened to New Orleans this year. The F. W. & D. C. R. R. Co. was incorporated in Texas, to build a road from Fort Worth to the Canadian river, 385 miles; of this 143 miles have been completed. The new line will probably connect with the San Antonio & Aransas Pass R. R. which will give access to the harbor at Aransas Pass, Tex., where a deep water channel is to be made.

Welland Canal.—The contractors for the canal improvement are pushing their work rapidly to completion, and it is expected that by the middle of June there will be a depth of 14 ft. through the entire length of the canal. The Dominion Parliament will be asked to vote a sufficient sum to enable the government to proceed at once with the enlargement and deepening of the St. Lawrence canal to a uniform depth with the Welland, and so to admit of a vessel passing from Chicago to the Atlantic without lightening her cargo.

Arthur Kill Bridge.—The Secretary of War has authorized the construction of the Arthur Kill bridge, subject to the requirements of the rule of the Department of July, 1886. It will consist, therefore, of four spans, with a swing bridge, as at first proposed and not of one span as called for in Senator McPherson's amended bill. The bridge will be built by the Rapid Transit Co., which has marketed $2,500,000 five per cent. bonds for the purpose. The bridge itself will cost about $400,000, and the remainder will be applied to extensions and improvements.

Railroad Companies.—Virginia, Parkersburg & Ohio R. R. Co.; from Parkersburg to Rider's Gap, W. Va., with a branch to the Chesapeake & Ohio R. R.; GIDEON E. MEIGS, ALLEN LEVERING and others.——Alpena & Petoskey R. R. Co.; in Michigan; Detroit and Petoskey parties are interested; capital stock, $600,000.——South Alabama Ry. Co.; from Columbia to Evergreen; JOHN T. DAVIS, A. D. WOOD and others; capital stock, $500,000.——Wilmington Sea Coast R. R. Co.; IREDEL MEARE, Wilmington, N. C.; capital stock, $100,000.——Macon & Tuscaloosa R. R. Co.; W. C. JEMISON, Tuscaloosa, Ala.——Peoria & St. Louis Air Line R. R. Co.; HOBART HAMILTON, Petersburg, Ill., and others; office at Petersburg; capital stock, $1,000,000.——Paducah, St. Louis & Chicago R. R. Co.; E. C. RICE and G. W. UPDIKE, St. Louis, Mo.; office at East St. Louis, Ill.; capital stock, $100,000.——Alabama Midland R. R. Co.; Montgomery to Chattahoochee.——Augusta, Thomasville & Gulf R. R. Co.; 250 miles; GEORGE W. STETSON, New York City, W. T. GAREY, Augusta, Ga.; capital stock, $3,500,000.——Newburg & Poughkeepsie R. R. Co.; from New Windsor, N. Y., to the Poughkeepsie bridge; S. W. ROSENDALE, R. C. PRUYN, of Albany, N. Y., and others; capital stock, $500,000.——Wisconsin Midland Ry. Co.; from Chicago to Fond du Lac, Wis., and to Ontonagon or L'Anse, Mich., with a branch to Sturgeon bay; incorporated at Madison, Wis.; capital stock, $3,000,000.——New Orleans, Natchez & Fort Scott R. R. Co.; from Fort Scott, Kan., to Kansas City, Mo.; J. H. RICE, Fort Scott; capital stock, $3,000,000.——Kansas & Gulf Ry. Co.; several lines in Kansas, 900 miles; OSCAR JOHNSON, Lindsburg, Kan.; capital stock, $1,000,000.

New Lines and Extensions.—Maysville & Big Sandy R. R. Mr. C. P. HUNTINGTON has given orders to the contractors to push the work so as to have the road in operation by July 4.——Bangor & Piscataquis R. R. A line will be built from Milo to Bangor, Me., through Kenduskeag, Corinth and Charlestown. The survey has been started.——Kansas City, Memphis & Birmingham R. R. Work is progressing in Monroe county, Miss., and the earthwork and bridging will be completed in four months.——Maine Central R. R. The line will be double tracked from Portland to Cumberland junction, seven miles; estimated cost, $125,000.——Chicago & Eastern Illinois R. R. The Grape Creek extension from Danville to Tuscola, Ill., will be built soon.——Talladega & Coosa Valley R. R. The line will be extended to connect with the East & West R. R. in St. Clair county, Ala. D. M. ROGERS, president, Renfroe, Ala.——Fort Worth & Rio Grande R. R. The line from Fort Worth to Grandbury, Tex., is graded for 38 miles and track laying has been commenced at Fort Worth; the track will be laid to Grandbury by April.——Birmingham, Georgia & Florida R. R. A road will be built this year from Birmingham, Ala., to Tallahassee, Fla.——Ohio & Northwestern R. R. The line will run from Point Pleasant, W. Va., to Cincinnati, O., and to the Ohio Valley R. R. which is to be extended to Pomeroy; the Cincinnati & Eastern and Cincinnati & Portsmouth railroads have been purchased and will be rebuilt; the 53 miles from Gallipolis to Portsmouth will be completed by August. President, H. C. PARSONS, of Point Pleasant, W. Va.

Southern Pacific R. R. Grading is in progress between San Buenaventura and Santa Barbara, Cal.——Minnesota & Northwestern R. R. Right of way is being secured from Freeport, Ill., to the Mississippi river.——Kentucky Union R. R. Several extensions are contemplated; F. D. CARLEY, of Louisville, Ky., is interested.——Wheeling & Lake Erie R. R. It is proposed to extend the line from Milan to Sandusky, O., about 12 miles; the city engineer is making the survey.——Louisville & Nashville R. R. Work is in progress on the Bardstown branch, 22 miles; the Cumberland Valley line, 30 miles; from Clarksville, Tenn., to Princeton, Ky., 57 miles; the Nashville & Florence R. R. is being extended 25 miles to Sheffield, Ala., and the Mineral R. R. is being extended 13 miles.——St. Louis, Arkansas & Texas R. R. Branches will be built from Chandler and Sulphur Springs to Fort Worth, Tex., from Corsicana to Hillsboro, and from Gatesville to Brownwood; 60 miles will be built from Magnolia, Ark., to Shreveport, La.

Illinois Central R. R. A branch of the Havana, Rantoul & Eastern line will be extended from Leroy to Clinton, Ill.——Cincinnati, Hamilton & Dayton R. R. Work has been resumed on the Piqua & Troy branch.——Baltimore & Ohio R. R. The road will be double tracked from Benwood to Moundsville, W. Va.——Atlantic Coast Line R. R. Two lines are to be built this year, one from the Wilmington, Columbia & Augusta R. R., at the Pee Dee river to Fayetteville, and the other from Sumter, N. C., on the same road, to Augusta, Ga.——Richmond & Danville R. R. The Northwestern North Carolina line will be diverged at Winston, N. C., and extended to Wilkesboro and Mocksville.——Ohio & Mississippi R. R. Work is being pushed on the branch from Watson to New Albany, Ind.——Franklin & Megantic R. R. A line is projected from Kingsfield, Me., to a railroad connection at Lake Megantic.——Texas, Santa Fé & Northern R. R. This line has been completed between Espanola, the terminus of the Denver & Rio Grande R. R., and Santa Fé.——Milwaukee & Northern R. R. The line is being extended to Champion, Mich.——Canadian Pacific R. R. The right of way is being cleared from Port Arthur to Whitefish Lake, for a connection with the Duluth & Iron Range line.——Chicago, Burlington & Northern R. R. The line will be extended from Dubuque or Lansing, Ia., into Dakota.——A railroad is to be built to the gold fields of Iowa; JOHN GILMAN, of Worcester, Mass., is interested.

Cleveland, Akron & Columbus R. R. Work has been commenced on the Dresden branch.——St. Paul, Minneapolis & Manitoba R. R. A line is to be built from Mouse river, Dak., to Great Falls, Mont., 700 miles; it will connect with the Montana Central R. R.——Marietta & San Jacinto R. R. Funds have been raised for the construction of this Indiana line.——Canadian Pacific R. R. The line to connect with the Maine Central R.R. at Mattawamkeag will be completed this year.——Denver & Rio Grande R. R. Work is in progress on the Aspen branch; the third rail will be extended to Leadville; grading is in progress from the Grand cañon to Salida.——Erie, Butler & Pittsburg R. R. The line will be built soon. Address HON. CHAS. M. REED, Erie, Pa.——Americus, Preston & Lumpkin R. R. The line will be extended from Antioch to Columbus, Ga.——Harmony & Wellington R. R. The line from Hartland, Me., to Wellington, will be built this season. D. E. THOMPSON, Hartland, Me.——Atchison, Topeka & Santa Fé R. R. The Pueblo (Col.) extension is to be built soon.

Proposals Open.

Bridge.—Steel railroad and highway bridge across the Missouri river between Council Bluffs, Ia., and Omaha, Neb. Proposals will be invited shortly.

Sewer.—Brick sewer, 8-ft. diameter, 1,400 ft. long. FRED J. RICKON, City Engineer, Little Rock, Ark.

Street Grading.—WILLIAM BARRETT, President, Board of Public Works, St. Paul, Minn. March 11.

Earth.—Earth embankment; 100,000 cu. yds. S WHINERY, C. E., Stanton House, Chattanooga, Tenn March 15.

Railroad.—Construction, grading and cross ties; 17.5 miles, from Buffalo to Roanoke. W. W. BARNES, Superintendent, East Alabama Railway, Opelika, Ala. March 15.

Jails.—For Rusk county. J. H. WOOD, County Judge, Henderson, Tex. March 15.

At Oswego, N. Y. (except steel and iron work and steam heating apparatus): PAULY JAIL BUILDING & MANUFACTURING CO., care of ARVIN RICE or A. SALLADIN, JR., Oswego, N. Y. March 15.

Water-Works.—To be let under one contract or in sections. Plans and specifications are ready for inspection, but different plans may be submitted. WM. MCKENZIE, Reeve, Morrisburg, Ont., Canada. March 15.

Bridges.—Two wrought-iron bridges; span 60 ft.; roadway 16 ft. wide; hard pine or oak flooring; on iron trestles with pile foundations; approaches; over Walnut creek. Bidders to furnish their own plans and specifications. S. B. MERRILL, Bridge Commissioner, County Clerk's Office, Ness City, Kan. March 16.

Water-Works.—Two compound, non-condensing, duplex pumping engines of 750,000 gallons daily capacity; two return tubular steel boilers; feed water heater; smoke connection and chimney; two boiler feed pumps; all connections, valves, etc., for a complete plant of 150,000 gallons daily capacity; pumping station; 564 tons of cast-iron pipe (4, 6, 8 and 10-in.), 25,000 pounds of special castings; 44 stop-valves; 60 double-nozzle hydrants; pipe laying, etc. Plans and specifications on file. Consulting engineer, JOHN W. HILL, Glenn Building, Cincinnati, O. THE TRUSTEES OF THE WATER-WORKS, Franklin, O. March 17.

Water-Works Supplies.—Pipe, castings, valves, trenching, etc. JACOB HALBACH, Superintendent of Water-Works, Lancaster, Pa. March 17.

Street Work.—For Avondale, O. W. ELWOOD WYNNE, Corporation Clerk, Sinton Building, Cincinnati, O. March 17.

Railroad.—Earthwork for realignmen: near North Bend, O.; about 450,000 cu. yds. of excavation and 25,000 cu. yds. of bank. T. O. MORRIS, Engineer Maintenance of Way, Cincinnati, Indianapolis, St. Louis & Chicago Railway, Indianapolis, Ind. March 19.

Stone Arch.—Double track, 60 ft., three-center arch over Otter creek, near Cornell station on Canada Southern Division; about 4,400 cu. yds. Foundations and centers prepared by the company. J. D. HAWK, Chief Engineer, Michigan Central R. R. Co., Detroit, Mich. March 21.

New Croton Aqueduct.—Shaft No. 13½, on Section 7. JAMES C. SPENCER, President, Aqueduct Commission, Stewart Building, New York City. March 25.

Buildings.—Stone masonry. A. J. MCGONIGLE, Chief Quartermaster, U. S. A., San Antonio, Tex. March 25.

Dredging.—In Connecticut river, below Hartford Conn. LIEUT. COL. D. C. HOUSTON, U. S. Engineer Office, Houston and Greene streets, New York City. March 26.

Water-Works Supplies.—Iron and brass castings, valve boxes, grates, pipe and specials, ferrules. THOMAS G. SMITH, President, Board of Public Affairs, Cincinnati, O. March 26.

Dredging.—Between Staten Island and New Jersey. LIEUT. COL. WALTER MCFARLAND, U. S. Engineer Office, Houston and Greene streets, New York City. March 30.

Bridge.—Iron bridge across the Guadalupe river. H. E. FISCHER, County Judge, New Braunfels, Tex. April 4.

Bridge.—Iron or steel superstructure, masonry and approaches for bridge across the Ste. Marie river and canal at Sault Ste. Marie, Mich. Work to be commenced immediately after signing the contract and to be completed by the end of November. P. ALEX. PETERSON, Chief Engineer, Sault Ste. Marie Bridge Co., office of the Canadian Pacific Ry. Co., Montreal, Canada April 4.

Dredging.—The following proposals for dredging at Coasters' Harbor island, R. I., were opened by W. S SCHLEY, Chief of Bureau of Equipment, Navy Department Washington, D. C., March 5; Chas. W. Anthony, Fall River, Mass., 36 cts. per cu. yd. John McDermott Cohoes., N. Y., 44 cts. Hartford. Dredging Co., Hartford, Conn., 45 cts. Staples & Phillips, Taunton, Mass., 47½ cts, The contract was awarded to Chas. W. Anthony.

Contracting.

Water Pipe.—The contract for the extension of the water mains at Concord, N. H., to West Concord, has been awarded to Goodhue & Birnie, of Springfield, Mass., at 74 cts. per ft. for 6 in. and $1.46 for 12-in. pipe.

Philadelphia Public Buildings.—The Public Building Commitee, on March 1, decided to stop present work on the main tower, and spend available money on the interior.

Water Pipe.—Dennis Long & Co., of Louisville, Ky., have the contract for this season's supply of cast-iron pipe and specials for Madison, Wis. There are now 18 miles of pipe and the extensions average about a mile a year.

Dredging.—At Buffalo, N. Y., the City Engineer has received proposals from Hingston & Woods for dredging in the river and canal at 23 cts. per cu. yd. and a total of $5,325.

Pier Work.—Proposals were opened March 9, at the Department of Docks, New York City, for repairing, widening and extending the pier at E 37th street, East river; the work was divided into three classes, dredging around curbs, crib dredging, and pier. The bids were as follows: John W. Flaherty, 30 cts., $1.50, $19,750; John D. Leary, 30 cts., $1.50., $20,000. The contract was awarded to John W. Flaherty.

Pumping Station.—Hicks, Holmes & Co. of Nashville, Tenn., are building the pumping station for the new water-works for that city.

Breakwater.—The contractors for the breakwater at Port Arthur, Ont., are making preparations to commence work. The new addition will be 2,500 ft. long.

Gas Works.—The contract for the erection of gas works for the city of Taylor, Tex., has been awarded to Messrs. Stein & Co., of Austin, Tex.

The Chattanooga Car & Foundry Co. is a reorganization of the Wason Car & Foundry Co., of Chattanooga, Tenn. The incorporators are C. E. JAMES, J. W. ADAMS and others.

Water-Works. (*Special Telegram*).—The franchise and contract for water-works at Pine Bluff, Ark., has been secured with favorable conditions by F. W. Raeder for the Water, Light & Power Co., St. Louis, Mo.

Jails.—The Pauly Jail Building & Manufacturing Co., of St. Louis, Mo., has been awarded the contract for the construction of the jail at Gretna, La., for $12,500.

At Henderson, Tex., a jail is to be built at a cost of from $15,000 to $20,000.

Tramway Engine.—C. A. Price, Marshall, Tex., is in want of an engine to haul rock on a tramway three miles long, from quarry to railroad. There will not be heavy grades.

Roads.—At Hopkinsville, Ky., a company has been incorporated by John C. Latham and others, with a capital stock of $90,000, to build about 40 miles of macadamized roads in Christian county.

Fence.—The contract for an iron fence, 1,003 ft. long, 5 ft. high, and built of ¾-in. pickets with spear tops, at the Almshouse, Buffalo, N. Y., has been awarded to the Champion Iron Fence Co., of Kenton, O., at $1.20 per ft.

Water Wheels.—The Water Commissioners of Manchester, N. H., have awarded a contract to T. H. Risdon & Co., of Mount Holly, N. J., for two 36-in. Risdon water wheels for the water-works. The contract price is $5,627.

The Georgia Construction & Investment Co. has been incorporated at Augusta, Ga., by ROBERT P. SIBLEY, WM. A. LATIMER, GEORGE R. LOMBARD, and others. The company will undertake the construction of roads, railroads, bridges, water-works, factories, etc. Capital stock, $100,000.

Bridges.—At Minneapolis, Minn., the contract for the steel arch bridge has been awarded to Horace E. Horton of Rochester, Minn., for $79,900, on the condition that the shop work is done at the Keystone Bridge Works, Pittsburg, Pa. (For list of bids see p. 164).

At New Haven, Conn., the contract for the masonry for the Consolidated R. R. bridge at Howard avenue has been awarded to R. Redfield & Sons, of New Haven.

At Denver, Col., the contracts for the Cherry Creek bridge have been awarded as follows: Superstructure, Phœnix Bridge Co., $5,600.49; substructure, McDermott & Beatty, Denver, stone, $18.95; concrete, $7.50.

The contract for tearing down the railroad bridge on the Panhandle line over Raccoon creek, near Burgettstown, Pa., and erecting a stone arch, has been awarded to Frederick Gwinner, of Pittsburg, at $50,00⁰. It will be 110 ft. long and 56 ft. wide.

The Phœnix Bridge Co., Phœnixville, Pa., has been awarded the contract for a bridge across the Potomac river, near Sheperdstown, W. Va., about 110 ft. high and in five spans of 167 ft. each.

The Vermont Construction Co., St. Albans, Vt., has been awarded the contracts for an iron bridge, 150 ft. long, at Center Rutland, on the Pittsford & Clarendon R. R., and for a bridge at Hartford, Vt., on the Central Vermont R. R.

Paving.—At Omaha, Neb., the following proposals have been received by J. E. HOUSE, Chairman of the Board of Public Works: For Sioux Falls or other granite, (*a*) on sand, (*b*) on broken stone and sand, (*c*) on concrete; A. R. Hoel, (*a*) $2.95, (*b*) $3.25. Whalen & Brennan, $2.80, $3.10, $4.20. Andrew Murphy & Co., (*a*) $2.80, (*b*) $3.19. J. E. Riley & Co., $2.69, $2.99, $3.28. Thatcher & Wilson, $3.12, $3.47, $3.74. W. Forristal, (*a*) $2.72. Patrick Fox (*a*) $2.79, (*b*) $3.17.—For Colorado sandstone; A. R. Hoel, (*a*) $2.95, (*b*) $3.25. Whalen & Brennan, $2.59, $3.05, $3.75. C. D. Woodworth, (*a*) $2.85, for alleys only. Andrew Murphy & Co., (*a*) $2.65, (*b*) $3.08. J. E. Riley & Co., $2.79, $3.09, $3.38. Thatcher & Wilson, $3, $3.34, $3.65. W. Forristal, (*a*) $2.72. Hugh Murphy, (*a*) $2.55. Patrick Fox, (*a*) $2.62½, (*b*) $3.05.—For cedar blocks; Whalen & Brennan, $1.69, $1.93, $2.03. Regan Bros & Co., $1.35, $1.61, $1.73. J. B. Smith & Co., $1.45, $1.59, $1.98. Andrew Murphy & Co. (*a*) $1.75, (*c*. $1.94. J. E. Riley & Co., (*c*) $2.08. Thatcher & Wilson. $1.52, $1.75, $2.20. Omaha Paving Co., $1.51, $1.61. $1.79) W. Forristal, $1 43, $1.63, $1.82. Hugh Murphy (*c*) $1.87 Patrick Fox, (*a*) $1.72, (*c*) $1.97. For macadam; (one and five year's guarantee); Regan Bros. & Co., $1.76, $2. For sheet asphaltum, (one and five year's guarantee), Barber Asphalt Paving Co., Washington, D. C., $2.95, $3.45.

Railroad Contracts.—Miller, McDonald & Co., have been awarded the contract for grading Branch No. 4 of the Fremont, Elkhorn & Missouri Valley R. R., the line is 70 miles long, from the Platte river bridge on the Lincoln branch to Seward county, Neb.

Shanahan & Co. have the contract for the construction of the Ohio & Northwestern R. R.: T. F. Powell, of this firm, will have headquarters at Portsmouth, O.

Evans & Taylor, of Augusta, Ky., have taken a large contract for the extension of the Louisville Southern R. R. and will commence work as soon as they complete their contract on the Maysville & Big Sandy R. R

William Duncan is the contractor for the construction of the Dresden branch of the Cleveland, Akron & Columbus R. R.

Isaac L. McKee & Co., of Memphis, Tenn., have been awarded the contract for seventeen miles of grading, masonry and trestling for the Indiana, Alabama & Texas R. R. between Cerulean Springs and Princeton, Ky.

H. C. Shump, of Boone Landing, Ky., has a contract for grading the Ohio & Northwestern R. R. between Portsmouth, O., and Sciotoville.

Holmes, Davis & Co., of Nashville, Tenn., have been awarded the contract for the construction of the railroad from Huntsville, Ala., to Elora, Tenn.

Brooks & Danford, of New York, have a contract for the construction of the Zanesville, Mt. Vernon & Marion R. R. in Ohio.

The Louisville, St. Louis & Texas R. R. Co. has awarded the contract for grading the line from West Point, Ky., to Stephensport, and work will be in progress by April. Capt. W. B. EALLS, Chief Engineer.

Asphalt Paving, Etc.—At Cincinnati, O., the only proposal for work on Ninth and Seventh streets, was from the Warren-Scharf Asphalt Paving Co., of New York City. For Seventh street, the price for 20,000 sq. yds. of asphalt, was $2.84, and the total bid, $105,208. The following table gives the details of prices for Ninth street:

Materials.	Quantities.	Warren-Scharf Asphalt Paving Co.	
Curbs, granite, 5 in....	15,000 lin. ft.	$1 38	$20,700.00
Curbs, circular 5 in....	600 lin. ft.	2.60	1,560.00
Curbs, reset 4 in.....	200 lin. ft.	.10	20.00
Curbs, reset 5 in.....	200 lin. ft.	.10	20.00
Curbs, reset 6 in.....	400 lin. ft.	.10	40.00
Crushed limestone....	1,000 cu. yds.	2.00	2,000.00
Asphalt paving.....	26,000 sq. yds.	2.75	71,500.00
Gutter flagging.....	31,600 lin. ft.	1.80	56,880.00
Readjust'g man's, etc.	30	3.00	90.00
Catch-basin, inlet st's.	22	6.00	132.00
Granite paving.....	1,300 sq. yds.	4.50	5,850.00
Valve caps.....	20	4.50	90.00
Manhole covers.....	40	12.00	480.00
Fire-cistern covers....	6	12.00	72.00
Catch-basins	40	95.00	3,800.00
Readjusting catch-basin drip-stones....	22	2.00	44.00
Drain pipe, 12 in.....	1,200 lin. ft.	1.70	2,040.00
Repairing intersect's...	1,500 sq. yds.	.50	750.00
Resetting gutters.....	600 lin. ft.	.15	90.00
Total.....			$166,158.00

Paving and Sewers.—The following proposals were opened March 7, at the Department of Public Works, New York City: (1) Curbing and flagging sidewalks on 117th street; Thomas Murray, curb, 59 cts. per ft.; flagging 24½ cts. per sq. ft., total, $1,909.20. D. W. Moran, 66 cts., 24 cts., $2,011.08. G. F. Masterson, 65 cts., 25 cts., $2,032.80. M. J. Kane, 65 cts., 25 cts., $2.032.80. Contract awarded to T. Moran.—(2). Flagging on West End avenue, Geo. F. Masterson, 26 cts., $1,085.86. M. J Kane, 26 cts., $1,085.86; D. W. Moran, 26½ cts., $1,106.16.

(3) Sewers in Hudson street; Patrick Reilly, $2,413.75. C. Smith, $2,955. T. A Smith, $3,035.75. G. F. Masterson, $3,287.50. Contract awarded to P. Reilly.—(4) Sewer in St. Nicholas avenue, M. Fay (incomplete). V. Del Genovese (incomplete). B. Gouin, $10,480. J. W. Phelan, $9,587.50. Contract awarded to J. W. Phelan.—(5) Sewer in 91st. street; P. Larney, $4,688. M. J. Kane, $5,008.75. P. M. Reilly, $5,341.50. T. A. Smith, $6,259.37. Contract awarded to P. Larney.—(6) Sewer in 100th street; J. W. Phelan, $860. M. J. Kane, $1,264.50. Contract awarded to J. W. Phelan.—(7) Sewer in 105th street, J. J. Montgomery, brick sewer, $4.50 per. ft.; 12-in. pipe culvert, $1.73; receiving basins, $187; rock excavation, $3.65 per cu. yd.; timber, $35 per 1,000 ft. B. M.; total, $15,031. G. F. Masterson, $5.25, $2, $200, $3.40, $40, $15,315. B. B Gouin, $3.50, 75 cts., $125, $4.37, $15, $15,365. V. Del Genovese, $7.25, 25 cts., $125, $5.95, $30, $23,405. Contract awarded to J. J. Montgomery.

Street Railroads.—The Texas & St. Louis Street Railway Construction Co., of Dallas, Tex., has been awarded the contract for the construction of the Texarkana Street Railroad. W. A. DISBOROUGH is secretary of the construction company.

Patrick Sullivan, of Atlanta, Ga., has been awarded the contract for the construction of a street railroad for the East Lake Land Co., of Birmingham, Ala.

Pipes and Specials.—The following proposals were opened March 7 at the Department of Public Works, New York City: (1) Stop-cocks, hydrants and boxes. (Withdrawn owing to incomplete specifications; the work will be readvertised).—(2) Cast-iron pipe and specials; John Fox, New York City, 2,250 tons of straight pipe, $30.25 per ton; 100 tons of branch pipes and special castings, $54 per ton; total, $73,462.50. Florence Iron Works; $31.20, $58, $76 000. McNeal Foundry & Machine Co., Burlington, N. J.; $32.05, $59, $78,012.50. Contract awarded to John Fox.

Paving.—At Albany, N. Y., the following proposals were received for the Broadway pavement: Thomas Reilly, $103,267.64. A. N. Brady, $104,461.88. Jacob Holler, $106,882.49. Patrick McQuade, $114,842.40. Emmet Flagler, Troy, N. Y., $121,326.94. Charles Guidet, New York, $156,991.06. E. J. McKeever, New York, (informal). The contract was awarded to Thomas Reilly at the following prices: granite pavement, $2.56 per sq. yd.; relaying granite, 70 cts. per sq. yd.; new sidewalks, $1.10 per ft.; relaying sidewalk, 50 cts. per ft.; curb, 80 cts.

per ft.; circular curb, $1.15 per ft.; bridge stone crosswalks, 15 cts.; flagging, 18 cts. per sq. ft.; brick, 6 cts. per sq. ft.; credit for old cobble, 5 cts.; credit for old curb, 3 cts.

Street Work.—At Buffalo, N. Y., the following bids have been received for work on the West side: Patrick Wright, constructing sidewalks, 16½ cts.; repairing sidewalks, 4 cts.; constructing crosswalks, 18 cts.; repairing crosswalks, 4 cts.; Robert F. Hankin, 16½, 3, 20, and 3 cts. William Ruehl, 16½ ½, 18 and ½ cts. Michael Scanlon (informal), 19½, 2, 21 and 2 cts. Franz H. Ewert, 15¾, 4¾, 19 and 6 cts. John Rackl, 17¾, 4, 19 and 4 cts. Alex. McDougal, 16, ¾, 17½, and ½ cts. The same bids were received for work on the East side, with the addition of Thomas McDonough, 16, 5 and 19 cts. for the first three classes of work.

At Columbus, O., the Warren-Scharf Asphalt Paving Co., of New York City, has been awarded the contract for asphalt paving at $4 per yard and for resetting curb at 15 cts. per ft.

At the village of Madisonville, O., street grading, paving and draining have been authorized.

At Little Rock, Ark., half a mile of sidewalk will be built. Address F. J. RICKON, city engineer.

At Skippackville, Pa., sidewalk improvements are to be made.

At Allegheny, Pa., a contract for grading and paving has been awarded to McNoughor & Co. at $994.10.

The New Albany Rolling Mill Co., New Albany, Ind., is turning out steel yokes and steel rails for the North Chicago Cable Co., and has recently declined an order from the Cable Railroad Co. of Philadelphia, for 5,000 steel yokes, owing to the large orders on hand. Preparations are being made for the extensive manufacture of beams, channels and general architectural iron.

Sewer.—At Albany, N. Y., a committee of the Park Commission has reported five plans for abating the Martinville sewer nuisance and converting the territory into a park. The estimates ranged from $30,950 to $261,900. The report states that the Martinville sewer, for at least 600 ft., is practically destroyed and must be rebuilt, the condition of the sewer where covered is stated by city employés to be in an unsafe condition. The plan recommended provides for a combined arch or sewer to connect with the sewer leading to the penitentiary grounds, and for grading and intersecting sewers; estimated cost, $59,200.

Sewer.—The following proposals were opened recently by City Engineer ALBERT H. HILL, of New Haven, Conn., for the construction of the sewer in the Boulevard from Kimberly avenue to Lamberton street:—

	C. W. Blakeslee & Sons, New Haven.	L. O'Brien, New Haven.	L. W. Burt, Hartford.	Harris & Maguire, Brooklyn, N. Y.	Matthew Kehoe, New Haven.
	$	$	$	$	$
Sewer, 250 ft. of 72-in. on piling...	26.60	27	30.00	29.50	28
Sewer, 1,550 ft. of 72-in. on grillage	22.10	23	25.50	25.85	27
Sewer, 80 ft. of 36-in. on piling...	10.80	11	12.50	14.00	13
Culvert, 70 ft. of 12-in.....	1.75	2	1.50	2.25	2
Catch basins, 2.....	110	120	100	120	115
Manholes, 5.....	65	70	50	45	100
Total.....	$42,436.50	44,010	48,580	49,185	50,920

The contract was awarded to C. W. Blakeslee & Sons.

Railroad Buildings.—The contract for the erection of the new depot at London, Ont., for the Michigan Central R. R. Co. has been awarded to A. Ellison of that city.

The Richmond & Danville R. R. Co. proposes to erect a passenger depot at Atlanta, Ga.

The Concord R. R. Co. will erect a new engine house and car shed and make other improvements at Manchester, N. H. A new passenger depot is contemplated.

The Chicago, Kansas & Nebraska R. R. Co. has awarded the contract for the new shops at Horton, Kan., to a Chicago firm for about $250,000. Work will begin at once.

The Missouri Pacific R. R. Co. has purchased 33 acres of land for machine shops at El Dorado, Kan.; $100,000 will be expended on buildings and improvements.

Street Work.—At Cincinnati, O., the following bids have been received by the Board of Public Affairs: *Macadam*; On Academy avenue, Duffy & McKeone, $5,602.10; M. Byrnes, $5,694.34; Hayes & O'Brien, $5,772.32; T. Lloyd, $5,982.59; J. F. Coughlin, $6,228; E. Buckley, $6,337.78; H. Leveeney, $6,484.78. On Apjones street, M. T. Flynn, $6,126.65; L. H. Rabe, $6,825.82; Hayes & O'Brien, $8,516.80. On Beech avenue, M. Byrnes, $8,218.37; H. Leveeney, $8,297.30; Duffy & McKeone, $8,332.99; T. Lloyd, $8,522.67; Hayes & O'Brien, $8,546.70; J. F. Coughlin, $9,463.09. *Asphalt*, On Seventh street, Warren-Scharf Asphalt Paving Co., $105,208; on Ninth street, Warren-Scharf Asphalt Paving Co., $166,158.

Grading, Curbing and Paving.—The following proposals were opened March 5 at Baltimore, Md., by A. E. SMYRE, City Commissioner, for work on Orleans street; Anderson & Kelty; grading, 17 cts. per cu. yd.; curbing, 39 cts. per lin. ft.; paving, 5¼ cts. per sq. ft. John E. Lyons, 19, 39 and 5¼ cts. Owen Patterson, 12½, 43 and 5¾ cts. A. Schneider & Son, 19, 40 and 6 cts. P. Reddington 17, 42 and 6 cts. James P. McGovern, 20, 40 and 5½ cts. W. R. Weaver & Co., 18, 39 and 5 cts. Henry Fox, 20, 40 and 5 cts.

Sewers.—At Allegheny, Pa., the following contract have been awarded: W. T. Duncan & Co., $6,230; Wm. M. Orr, $295.42; Lorence Sloan, $1,635; W. J. Dunn, $1,085, $657.50.

At Scranton, Pa., the following appropriations have been made for lateral sewers: $3,562, $5,050, $5,800, $5,837.50 and $6,888.50.

At Columbus, O., the following proposals have been received for 12 and 15-in. sewer: J. E. Gillivan, $837.10; E. M. Stanley, $860.50.

City Buildings.—At Union City, Tenn., it has been decided to erect a public building at a cost of $10,000.—At Toronto, Ont., a city hall and court-house building is proposed to be erected at a cost of $1,020,000.—At Youngstown, O., it has been proposed to erect a city building at a cost of $75,000; a public vote will be taken in April.—At Oshkosh, Wis., the contract for the city hall has been awarded to J. N. Ruby at $38,600.

IN PREPARATION. READY APRIL 1st.

Poor's Directory of Railway Officials

FOR 1887.

A SUPPLEMENT TO POOR'S MANUAL OF RAILROADS.

Cloth, 400 Pages, Royal Octavo. Price, $2.00 per Copy.

CONTAINING LISTS OF

Officers of all Steam Railroad Companies in the United States and Canada; Officers of all Street Railroad Companies in the United States and Canada; Officers of New Railroads now in process of construction, with data respecting Location of Lines, etc., etc.; Officers of Auxiliary Enterprises—Bridge and Union Depot Companies, Fast Freight Lines, Express, Sleeping-Car and Equipment Companies, etc., etc.; Officers of Industrial Enterprises Dependent on the Railway System—Car-Axle Manufacturers, Car Builders, Car-Wheel Manufacturers, Car-Spring Manufacturers, Rail Mills, Locomotive Builders, Bridge Builders, Contractors, etc., etc.; Officers of Associations of Railroad Officials and of Railroad Employees, Pools, Commissions, Boards of Railroad Commissioners, etc., etc.

TO THIS IS ADDED

An Alphabetical Index to the Names of all the Officials above mentioned, with a convenient system of reference, showing Lines with which each is connected; and

An Alphabetical Index of Cities and Towns, by means of which can be ascertained the Names of all Officials in any particular city or town at once.

FOREIGN RAILROADS.

In addition to the information given respecting the Railroads of the United States and Canada, the very excellent list of Railroads in Mexico, West Indies, Central America, South America, and Hawaiian Islands, given in last number of this work, and which proved such an acceptable feature of the book, will be very much improved and elaborated.

COMMENTS OF THE PRESS:

"The least that can be said of this volume is that it is as accurate as it is comprehensive it is far ahead of any publication of the kind which has yet been attempted, and will be an extremely useful work of reference."—*Railroad Gazette.*——"Brings within convenient compass most of the information required regarding railway officials. * * * The value of the book is so self-evident that a further review seems unnecessary."—*Railway News.*——"In its way, fully as valuable as the MANUAL."—*Boston Commercial Bulletin.*——"Of great value to the commercial industries of the country."—*London* (Eng.) *Bullionist.*——"Useful to those dealing with railroad companies."—*American Machinist.*——"Will undoubtedly prove of much value and service to many."—*Iron Age.*——"This immense compilation will be useful as a mailing guide. That there is a demand for it is evidenced by its publication; the Poors have a keen scent for success and know how to make it. The list of railways in Mexico, Central and South America, which concludes this volume is the neatest and most compact statement of the subject we have seen."—*New Orleans Picayune.*

COMMENTS OF RAILROAD OFFICIALS:

Office of PURCHASING COMMITTEE, WABASH, ST. LOUIS AND PACIFIC RAILWAY, 195 Broadway, New York, October 5, 1886.

Messrs. H. V. & H. W. POOR, 70 Wall Street, City.

Gentlemen:—I have received a copy of your Directory and find it to be a very complete and useful work of the kind. The indexes to officials and advertisements are particularly convenient, and when extended as you propose in the coming year will make the volume a practical business directory. Purchasing agents and others having these matters to classify will appreciate the great utility of the arrangement.

The book ought to be a a success.

Yours truly,
(Signed) O. D. ASHLEY, *Secretary.*
Wabash, St. Louis and Pacific Railway Co.

Office of the GENERAL PASSENGER AGENT, NEW YORK, LAKE ERIE AND WESTERN RAILROAD CO., New York, September 24, 1886.

Messrs. H. V. & H. W. POOR, Publishers of Poor's Directory, etc., 70 Wall Street, City.

Dear Sirs:—I am in receipt of copy of your Directory of Railway Officials and Railway Directors for 1886 and have examined the same and find it very complete. I am especially pleased with your classified Directory of Advertisements, by which parties desiring any kind of railroad supplies can turn to this index and immediately ascertain the names of parties advertising the kind of supplies they desire to obtain.

Yours truly,
(Signed) JNO. N. ABBOTT, *General Passenger Agent.*

Advertising rates and all other information will be furnished on application to

POOR'S MANUAL OF RAILROADS,
70 Wall Street, New York.

Notice To Contractors.

Proposals for building dam on Gilbert Run for Bradford, Pa., Water-Works. Sealed proposals will be received for building dam for reservoir on Gilbert Run, at the office of City Clerk, until the 21st day of March, 1887, at 5 o'clock P. M. of that day.

Bidders will be required to accompany their proposals with a bond in the sum of $100, duly executed by the party or parties making the proposal and two sureties as a guarantee that the bid is made in good faith. Bidders will give price of each kind of work and material in detail. Plans and specifications can be seen at the office of City Clerk Specifications and blank forms for bids and bonds will be furnished by the City Clerk, and all bids MUST be on these blanks and endorsed "Proposals for building dam." The Councils reserve the right to reject any and all bids. JAS. A. LINDSEY, City Clerk.

Bradford, Pa., March 7, 1887. 11-1t.

U. S. ENGINEER'S OFFICE,
JACKSONVILLE, Fla., March 8, 1887.

SEPARATE SEALED PROPOSALS, in triplicate, for dredging at each of the following places, will be received at this office until 12 o'clock noon, standard time, on April 11th, 1887, and will be opened immediately thereafter, for dredging in, 1st, Harbor at Cedar Keys, Fla.; 2d, Tampa Bay, Fla.; 3d, Manatee River, Fla.

Total amount available for the three works, $25,000.

Specifications, instructions to bidders and blank forms for proposals may be obtained at this office.

W. M. BLACK,
11-4t Captain of Engineers, U. S. A.

Wanted—A Civil Engineer of twelve year's practical experience on location and construction, desires a position as Division or Assistant Engineer on construction. Has had charge of important work the past five years. Can furnish the best of references. Address, Civil Engineer, Engineering News. Tribune Building. 11-2t.

Main Trunk Sewer in the City of Yonkers, N. Y.

SEALED PROPOSALS for the work of building a trunk sewer in the City of Yonkers, about one mile in length, will be received by the Common Council, on Wednesday, March 30, 1887, at 5 o'clock P. M. The plans may be seen and specifications obtained at the office of the City Clerk.

By order of the Common Council.

J. HARVEY BELL, Mayor.

W. H. DOTY, City Clerk. 11-3t.

Wanted,—A Neat Draughtsman. Must be good letterer and rapid workman, and accustomed to working ten hours a day. Address, stating age, experience and lowest salary, with samples of lettering and free hand and right line drawing. "Letterer," Care Engineering News, New York City.

PROFESSIONAL PAPERS.

The *JOURNAL OF THE ASSOCIATION OF ENGINEERING SOCIETIES* gives each month the best of papers read before six of the leading Clubs of Engineers; also *A MONTHLY INDEX* to the current literature of the profession.

Now in its fifth yearly volume.

$3.00 a year, 30c. a number.

Send for circulars to

H. G. PROUT, Secretary.

Chambers St., New York City.

BOOKS AND SUPPLIES For Engineers, Architects, Surveyors, Draughtsmen, Railroad Construction, and for Scientific and Technical Schools. FOR SALE BY Engineering News Pub. Co. Tribune Bldg. N. Y. City.